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UNITED STATES DEPARTMENT OF AGRICULTURE

Soil Survey
of
Mayes County, Oklahoma

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Bureau of Chemistry and Soils
In cooperation with the
Oklahoma Agricultural Experiment Station

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SOIL SURVEY OF MAYES COUNTY, OKLAHOMA

By M. H. LAYTON, United States Department of Agriculture, in Charge, and O. H. BRENSING, Oklahoma Agricultural Experiment Station

COUNTY SURVEYED

Mayes County is in the northeastern part of Oklahoma (fig. 1). Pryor, the county seat is about 40 miles northeast of Tulsa and about 70 miles southwest of Joplin, Mo. The shape of the county is rectangular. Its east-west dimension is 24 miles and its north-south dimension about 30 miles. The total area is 676 square miles, or 432,640 acres.

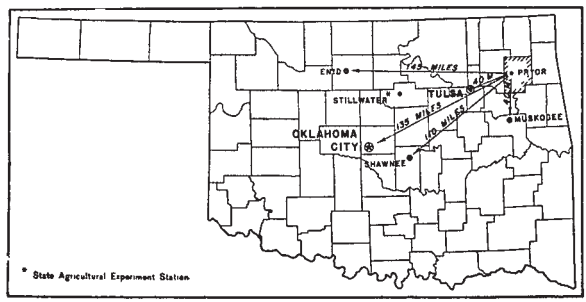

FIGURE 1.—Sketch map showing location of Mayes County, Okla.

Physiographically this county lies in two provinces—the Ozark region and the Prairies. The eastern part comprises the foothills of the Ozarks which gradually slope westward toward Neosho River. Erosion has cut deeply into the rocky Ozark section, leaving the more resistant rocks near the surface in the form of irregular fragments. The open undulating prairie, lying west of Neosho River, slopes gently eastward to the Ozark section and is characterized by a low tableland with eastward-facing escarpments which show exposed sandstone in many places. The dip of the bedrock is westward. Thin sandstone and limestone beds in the softer shales mark low terraces and benchlike forms which border shallow valleys, and, here and there in the western part of the county, low buttes, or conical prairie hills, have been preserved by the capping by harder strata. Westward-sloping forested hills also occur here. The harder formations of sandstone determine the location of the tableland and escarpments, and the shales coincide with the rolling to flat lands. Neosho River has modified the somewhat indefinite boundary between the two provinces and has masked it with deposits of alluvium.

The range in elevation is not great, but the higher elevations are in the eastern part of the county. According to the United States Geological Survey topographic sheets, the elevation in the southeastern part near the county boundary is 1,150 feet, and in the western part it is approximately 950 feet. The elevations of the principal towns along the Missouri, Kansas & Texas Railway are as

follows: Adair approximately 650 feet, Pryor 625 feet, and Choteau 625 feet.

Drainage is effected through Neosho River and numerous small tributaries which head in the hilly areas and flow in a southerly direction. Stream dissection in the eastern part of the county is much deeper and the slopes to the streams are much steeper than in the western part. Some of the streams in the eastern part are fed by springs and flow throughout the year, but those in the western part are intermittent, as they dry up, for the most part, during prolonged dry periods, but water holes remain.

The native vegetation of the prairie section consists almost entirely of tall grasses, the most abundant of which are the bluestems—*Andropogon* and *Panicum* species—intermixed with a number of wild legumes, such as prairieclover, hoary pea, or catgut, and a *Psoralea*, or wild alfalfa. Some short grasses, species of grama, grow on some of the prairie soils. In overgrazed pastures, cheat, poverty grass, and many kinds of weeds have come in, and the growth in places is much thicker than the original stand of native prairie grasses. On the steeper slopes the vegetation consists of shrubs and vines, such as butternut, woodbine, dogwood, sumac, wild grape, and persimmon. The alluvial lands originally supported a forest cover and in places, marsh grasses. The principal trees were elm, ash, pin oak, pecan, papaw, walnut, hawthorn, cottonwood, hackberry, locust, maple, willow, sycamore, black oak, and bur oak, many of which attained large size. Pecans grow very abundantly in most of the bottoms.

The native vegetation of the Ozark section consisted principally of a dense growth of post, blackjack, and red oaks, together with some hickory, locust, and pine, and a few chinquapin, haw, shittim wood, persimmon, and Osage-orange trees. The grassy vegetation here is thin, consisting principally of broomsedge, wild oatgrass, and needlegrasses. In many places the surface is nearly barren of vegetation and is covered with a thin layer of leafmold.

Mayes County was originally a part of the land tract held by the Cherokee and Creek Nations. It became a county in 1907, at the time Oklahoma became a State. Many traders had settled over this part of the country as early as 1846, but they could not obtain title to land prior to the Curtis Act of 1902, although land fenced was generally considered the settler's holding when the land was allotted to the Indians.

The population has increased gradually since statehood was granted. The white population has increased rapidly, and intermarriage between Indians and whites has resulted in considerable commingling of the races. The population in 1930 was 17,833, all classed as rural, with a density of 26.5 people to a square mile. Most of the early settlers were from Georgia and other Southern States, but after this territory was opened for settlement people came from many other parts of the United States.

The principal towns are Pryor, the county seat, and Adair, Choteau, Locust Grove, Salina, Strang, and Spavinaw, all small trading and shipping points located in various sections.

Two railroads—the Missouri, Kansas & Texas and the Kansas, Oklahoma & Gulf—afford connection with large markets. Most of the farms are within a short distance of shipping points, from which

carloads of hay, grain, and livestock can be shipped, making long hauls unnecessary; and motorbus and truck lines cross the county, providing adequate transportation facilities. The State and Federal roads are graveled or oiled and are well maintained, but the dirt roads are kept in only fair condition and during rainy seasons are difficult to travel. Most of the roads in the smooth areas follow section lines, but those in the rougher areas follow streamways and ridges.

The early settlers maintained good schools, and the public-school system has advanced adequately to meet the demands of the inhabitants. More than 60 schools are distributed at convenient points throughout the county, and each town has a high school. Churches of various denominations are located at convenient intervals.

The main occupations are general farming and livestock raising. Much prairie hay, cotton, grain, livestock, and dairy and poultry products are marketed outside the county, either by local dealers or private individuals. The greater part of the grain is sold through local elevators or fed on the farm. Much of the hay is baled and shipped to outside markets. The cotton is hauled and ginned at the conveniently located gins and then shipped to large cotton markets. Livestock raising is of considerable importance, owing to the adequate supply of hay and pasture. Grapes and small fruits are a source of some revenue.

The wooded areas supply material for making railroad ties and fence posts, and numerous small-tool handles and similar woodwork are produced from the hardwoods in the eastern part of the county. A few small sawmills are in operation. A small quantity of coal is mined in the northwestern part.

CLIMATE

As the climate is continental, it is characterized by wide seasonal variations. There is an unusual combination of sunshine and rainfall. More than two-thirds of the rainfall occurs during the growing season, from April to October, inclusive. The summer rains generally come in the form of thunderstorms of short duration, but the winter rains are generally slow and extend through long periods during which the atmosphere is very moist. The winters are usually mild, and zero temperatures are uncommon. In extreme cold periods the temperature does not remain below zero for more than 24 hours, as a rule. Blizzards are very infrequent and are generally of short duration. In the summer, the weather becomes very warm, especially during times of drought. Temperatures of 100° F. are common, but they last only a few days each season. Damage by drought may occur during July and August and is due as much to the high rate of evaporation, caused by the wind movement and excessive sunshine, as to deficiency of rainfall. The last of March and the first of April is considered the windiest period of the year, and wind movement is least during August. There is a marked variation in the average daily wind velocity which increases toward the warmest part of the day and falls at night. The most damaging winds are the "hot winds" which usually occur only during a prolonged heated period. They often reach high velocity and cause great injury to growing crops, especially to corn. Fortunately they

are uncommon and irregular. High northerly winds often precede and accompany cold waves.

The average date of the last killing frost is April 6 and of the first is October 22, which gives an average frost-free season of 199 days. Frost has occurred as late as May 8 and as early as September 29.

Table 1 gives the normal monthly, seasonal, and annual temperature and precipitation as recorded at the United States Weather Bureau station at Vinita, Craig County. Vinita is about 25 miles north of Pryor, and the data from this station may be considered fairly representative of climatic conditions in Mayes County.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Vinita, Craig County, Okla.*

[Elevation, 702 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1910)	Total amount for the wettest year (1927)	Snow, average depth
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*	*Inches*
December	38.4	75	−16	2.41	0.50	2.61	3.0
January	35.8	76	−16	2.01	2.11	2.52	3.4
February	40.1	82	−27	1.73	2.08	.89	4.5
Winter	38.1	82	−27	6.15	4.69	6.02	10.9
March	49.7	95	5	3.41	.93	4.73	.1
April	59.1	90	20	4.47	3.43	7.53	(1)
May	66.9	97	27	5.50	7.10	3.11	.0
Spring	58.6	97	5	13.38	11.46	15.37	.1
June	75.5	107	43	5.49	1.50	11.03	.0
July	79.6	108	49	3.88	3.05	7.30	.0
August	79.6	110	45	4.16	5.60	8.10	.0
Summer	78.2	110	43	13.53	10.15	26.43	.0
September	73.4	105	30	3.44	.90	3.93	.0
October	60.7	96	14	3.67	1.98	4.27	(1)
November	48.8	85	9	2.98	.04	3.09	.7
Fall	61.0	105	9	10.09	2.92	11.29	.7
Year	59.0	110	−27	43.15	29.22	59.11	11.7

[1] Trace.

AGRICULTURE

The early settlers found the prairies covered with a heavy growth of grass and the intervening narrow wooded valleys occupied by streams. The valleys furnished the locations for the homes, owing to the convenient supply of water and wood. The eastern part of the county, including the Spavinaw and Spring Creek hills, was forested with various oaks, hickory, and pine. Many hogs were raised on the acorns and nuts produced in this section, and the more open prairie land was used for raising cattle and horses. These practices have continued to a great extent to the present, although a more diversified type of farming is gradually replacing them. Livestock is now largely raised on the farms in conjunction with the production of farm crops.

The development of agriculture in this county has been built very largely around some kind of livestock raising. Corn and garden crops for home use were the first crops grown by the early settlers, and these were followed by small patches of cotton, oats, wheat, and fruits. As farm crops were not always grown successfully, owing to droughts and insect pests, the raising of cattle was a much more satisfactory farm activity to the first settlers. The raising of poultry and hogs and the growing of grain sorghums, cotton, small grains, and a few legumes have been the general practices since the earliest settlement.

General farming is the chief type of agriculture. Corn has been the most important cultivated crop and cattle the most important kind of livestock since early settlement. Corn originally was planted on the larger part of the crop area, but, as the virgin fertility of the soil was lessened by erosion and continuous cropping, due to poor management, the acreage devoted to corn became smaller, and that devoted to other cereal crops, mostly wheat, oats, and grain sorghums, increased.

Oats show an increase in acreage since 1909 but a decrease in average yields. The acreage devoted to wheat increased markedly during the World War, but since that time has shown a great reduction. Wheat receives the greater part of the fertilizer used. The acreage in cotton has steadily increased.

Wild hay is an important crop, and the average acre yield has remained fairly constant. According to local information, overgrazing has increased the acre requirement of grass per head of livestock about one-third. Alfalfa and other legumes are grown in some sections, especially on the bottom lands. They have gained in importance since their introduction. Sorgo (sweet sorghum), peanuts, tobacco, and broomcorn are minor crops. Potatoes and sweetpotatoes are grown, mainly in small quantities for home use.

Most farmers have small home gardens. In most years, fruits and vegetables are produced in sufficient quantities for home use, but little commercial production is reported, although a few commercial orchards are being developed, mainly of apple and peach trees, with some pear, plum, and cherry trees. Many of the trees die from disease and lack of care. Many farmers have small patches of melons, strawberries, blackberries, and raspberries, and some have good vineyards.

Poultry and eggs are produced on nearly every farm. The 1930 Federal census reports 290,625 chickens raised in 1929, with a value of $213,464; and 1,199,212 dozens of eggs produced, valued at $311,795. The same census reports 2,914,856 gallons of milk produced in 1929. In the same year 249,950 pounds of butter were churned, the total value of which was $177,473. The numbers of horses, cattle, goats, and swine have decreased slightly since 1920. The Federal farm census for 1935 reports 6,083 horses, 2,784 mules, 32,115 cattle, 3,613 sheep, and 16,660 swine in the county on January 1 of that year.

Commercial fertilizers are used to only a slight extent. They are used almost exclusively on the upland soils in the production of wheat and legumes. In 1929, 92 farms reported the use of fertilizer with a total expense of $4,184, and in 1920, only 34 farms reported the use of fertilizer at an expense of $3,824. Fertilizers high in phos-

phates are in general use. Lime is used by some farmers in growing soybeans, clover, and alfalfa.

Farm labor is generally plentiful. In 1929, $80,226 was expended for labor on 720 farms reporting such expenditure.

In 1935, 45.4 percent of the 2,810 farms were operated by owners and part owners, 54.2 percent by tenants, and 0.4 percent by managers. Many of the tenants are farming land owned by relatives and at some future date will inherit it. Farms differ considerably in size, ranging from about 10 acres to 1,500 acres, and the average is about 112 acres. Most of the tenant farms are operated on a crop-share basis.

The farmhouses are, as a rule, small wooden structures, and many are unpainted. Most of the barns are small and of open structure. The fields are usually well fenced, and in the eastern part of the county where free range is allowed, the cropland is especially well fenced. Grain drills, harvesters, tractors, mowers, hayrakes, cultivators, disks, hay presses, and plows are used where the acreage in crops is sufficient to require such machinery. The work animals are horses and mules of light or medium weight. Automobiles and trucks have, for the most part, replaced horses for heavy hauling and driving.

Table 2 gives the acreage devoted to the principal crops grown in this county in 1909, 1919, 1929, and 1934.

TABLE 2.—*Acreage of the principal crops in Mayes County, Okla., in stated years*

Crop	1909	1919	1929	1934
	Acres	*Acres*	*Acres*	*Acres*
Corn	63,432	25,983	58,440	19,473
Oats	5,451	49,244	17,283	35,443
Wheat	2,755	42,030	13,030	11,193
Sorghums	306	1,564	3,144	6,639
Tame hay	553	4,775	2,787	2,807
Wild hay	17,266	22,686	19,654	26,423
Cotton	2,365	7,607	9,663	11,407
	Trees	*Trees*	*Trees*	*Trees*
Apples	48,416	21,365	19,653	(1)
Peaches	12,487	31,303	10,588	(1)
Plums	1,476	2,624	2,802	(1)
Pecans	207	2,052	2,731	(1)

[1] Not reported.

Thirty-five or forty years ago, beef cattle and a few hogs were the principal livestock. In those days the land had hardly been touched by the plow, only one railroad crossed the county, and markets were few and distant, although herds of cattle were driven to market. The cattle were of inferior quality and largely infested with the ticks which cause tick fever, a severe disease of cattle. The quality of the cattle was improved gradually through the introduction of good bulls, and in time the tick infestation was reduced, so that by 1921 many farmers had herds of purebred and high-grade beef cattle. The depression just after the World War brought financial failures among many farmers and cattlemen and caused the loss of much of the purebred livestock, as many of the herds were dispersed. There are still breeding animals of good quality, although it is said they are fewer than in 1920. There are a few good herds of Herefords.

Apparently good opportunities still exist for the successful production of beef cattle, although prices and other economic considerations will determine the expansion or decrease of cattle raising.

The number of dairy cattle has been gradually increasing for the last 15 years. As the larger farms have been reduced in size and more farms have been placed in operation, the farmers have added more cattle of the dairy type for the production of milk and butter for home use and some for local sale to creameries. The Jersey and Holstein-Friesian breeds are commonly used for the production of milk. The quality of many dairy cows is not high, and many cows are being milked that probably do not make a justifiable return for the expense of their upkeep. This county is well suited for dairying, as the winters, on the whole, are mild and short, and feeds of many kinds are grown easily. Good markets are not far distant, and a cooperative creamery in the adjoining county purchases milk and cream from a number of the Mayes County farmers.

Pasture grasses can be grown nearly throughout the year, by beginning in the winter with winter oats, wheat, and barley, which grow well into the spring, and supplementing them with orchard grass and redtop. The native bluestem, which is plentiful in most sections, when reinforced with hop clover and lespedeza, also provides good pasture. Sudan grass provides excellent grazing in July and August, and roughage, such as soybeans, cowpeas, and the sorghums, can be grown on most farms. As the winters are short and mild, little expense is required to provide shelter for livestock.

Most farmers raise a few hogs for home use and for local sale. The predominant breeds are Poland China and Duroc-Jersey, and most of the hogs are of good quality. Hog cholera is prevalent, owing to lack of supervision on the free range in the rough lands east of the river, and stomach worms also cause losses. These diseases, however, can be controlled through proper sanitation and inoculation. Many carloads of hogs are shipped each year to outside markets. As the soils in most parts of the county are low in available calcium and phosphorus, it seems to be advisable to supply these two elements to all livestock in order to obtain the best results.

Only a small number of sheep are raised.

Poultry raising is increasing, as most sections of the county are suited to various kinds of poultry which are raised on practically every farm, but at present there are only a few commercial poultry farms. The predominating breeds of chickens are Leghorn, Plymouth Rock, Rhode Island Red, and Wyandotte. The climate is favorable for raising poultry, and, on many farms, the sale of poultry products has provided a small but much needed additional income.

SOILS AND CROPS

Mayes County is in a section of very dark brown typical Prairie soils which are extensively developed northward far into Kansas and Missouri but which gradually decrease to very small areas in the Oklahoma counties to the south. Interspersed ridges, knobs, hills, and eastward-facing escarpments characterize the landscape in the western part of the county. The resulting areas of shallow and stony soils and rough land are of low productivity. The forested areas here are known as the "cross timbers." In the eastern part,

approximately bounded on the west by Neosho River, is the western limit of the hilly and generally stony soils of the Ozark region, of which large areas in this county are too stony for the production of farm crops. Dark and highly productive soils occur in strips of alluvial bottom land along the larger streams.

The Prairie soils have developed chiefly from shales, limestones, sandstones, and interbedded shales and sandstones. Most of these soils are smoothly undulating and are deeply developed, although some areas, chiefly ridges and steep slopes, have shallow soils, with slightly developed thin layers, which are of low value for crops. Some areas of the smooth Prairie soils include spots of severely gullied and eroded land, and in other places there are areas of flat, imperfectly drained soils with claypan subsoils. These soils are limited in their suitability to crops and are characterized by low productivity. The soils of the stream bottoms, where well drained, are very productive. They are well suited to corn, alfalfa, and several other crops. Large areas of the smoothly undulating Prairie soils are very productive and are extensively used for all the crops commonly grown here, chiefly corn, cotton, small grains, grain sorghums, and various feed crops. The flat or very gently undulating Prairie soils with dense claypan subsoils are generally better suited to small grains and to the sorghums than to corn or alfalfa. The lighter textured sandy soils—the fine sandy loams—are well suited to vegetables, berries, fruits, and truck crops, although fair yields of the general farm crops can be produced. These soils respond especially well to care and fertilization. Cotton grows on all the cultivable soils, but the best yields are obtained on the well-drained alluvial soils.

The soils of this county may be divided into two groups—arable soils and nonarable soils—according to possibilities of cultivation. The arable soils are those which physically and topographically allow cultivation with tillage implements, and the nonarable soils are those which are too rough, too stony, or too shallow for successful cultivation.

The arable soils may be further divided into two groups: (1) Soils on which successful cultivation and production of crops may be systematically practiced and (2) soils of marginal value for cultivated crops, which, because of certain characteristics causing limited adaptations to crops, render the continuous and satisfactory production of most crops very uncertain.

On the basis of soil characteristics which influence crop production and general land use the soils are grouped and discussed as follows: (1) Dark Prairie soils with crumbly subsoils, (2) light-brown or grayish-brown soils with dense subsoils, (3) light-textured very permeable upland soils, (4) well-drained alluvial soils, (5) imperfectly drained alluvial soils, and (6) nonarable soils and rough lands.

In the following pages, the soils of Mayes County are described by groups and individually; their agricultural relationships are discussed; their location and distribution are shown on the accompanying soil map; and their acreage and proportionate extent are given in table 3.

TABLE 3.—*Acreage and proportionate extent of the soils mapped in Mayes County, Okla.*

Soil type	Acres	Per-cent	Soil type	Acres	Per-cent
Bates very fine sandy loam	67,008	15.5	Verdigris silt loam	21,888	5.0
Bates fine sandy loam	26,048	6.0	Verdigris very fine sandy loam	5,248	1.2
Summit silty clay loam	22,656	5.2	Verdigris silty clay loam	1,216	.3
Summit very fine sandy loam	4,032	.9	Huntington gravelly silt loam	5,440	1.3
Labette silt loam	6,656	1.5	Lightning silt loam	2,048	.5
Newtonia very fine sandy loam	128	.1	Lightning silty clay loam	3,328	.8
Parsons silt loam	64,384	14.9	Summit stony clay loam	8,384	1.9
Cherokee silt loam	5,824	1.3	Eldorado stony clay loam	3,328	.8
Woodson silty clay loam	5,440	1.3	Hanceville stony loam	5,312	1.2
Craig silt loam	23,488	5.4	Okoee stony loam	60,096	13.9
Lebanon very fine sandy loam	10,752	2.5	Rough stony land (Hanceville soil material)	12,544	2.9
Lebanon very fine sandy loam, shallow phase	25,280	5.8	Rough stony land (Leslie soil material)	6,400	1.5
Hanceville fine sandy loam	6,464	1.5	Mine pits	128	.1
Bates fine sandy loam, shallow phase	14,272	3.3			
Riverton very fine sandy loam	12,352	2.8	Total	432,640	
Riverton very fine sandy loam, high-terrace phase	2,496	.6			

DARK PRAIRIE SOILS WITH CRUMBLY SUBSOILS

The dark Prairie soils with crumbly subsoils include Bates very fine sandy loam, Bates fine sandy loam, Summit silty clay loam, Summit very fine sandy loam, Newtonia very fine sandy loam, and Labette silt loam. These are dark deeply developed soils of fairly high inherent fertility, whose physical characteristics give them a rather wide range of suitability for crops and allow satisfactory cultivation. These soils, as a group, are rather extensive, although some of the members are of very small extent.

The combined area of the soils of this group is 197.7 square miles, or 29.2 percent of the total area of the county. The chief areas of the well-drained prairie uplands are occupied by these soils. The virgin soils were originally moderately well provided with organic matter. The topsoils are easily cultivated, and the subsoils are sufficiently permeable to allow adequate underdrainage, although they contain sufficient clay to prevent leaching and to have good moisture-holding capacity.

The Bates soils are the most extensive soils of the group. They are deeply developed over beds of shale and sandstone and are suited to the production of corn, cotton, small grains, sorghums, and some other feed crops.

The Summit, Labette, and Newtonia soils are undulating, well-drained, and productive deeply developed Prairie soils overlying limestone or calcareous gypsiferous shale. The Summit soils are very dark, and the Labette and Newtonia are somewhat red. These soils, especially the Summit, are said to be better soils for corn than are the other upland soils. All the general farm crops are grown on them.

The soils of this group are more extensively cultivated, in proportion to their total acreage, than are the soils of any other group, except the well-drained alluvial soils. Most of them occur in the western part, west of Neosho River. The Newtonia and Labette soils are of only small extent and occupy small areas in a north-south belt across the central part of the county. They are associated with the larger areas of the Summit soils.

Bates very fine sandy loam.—The 8-inch topsoil of Bates very fine sandy loam is grayish-brown very fine sandy loam which, when moist, is brown or dark brown. It is friable and easily cultivated. The subsurface layer, or upper part of the subsoil, is brown, grayish-brown, or yellowish-brown heavy very fine sandy loam or clay loam, which, at a depth ranging from 14 to 18 inches, is underlain by yellow or brownish-yellow friable crumbly clay or heavy clay loam. This material, in places, contains an appreciable quantity of sand. At a depth ranging from 3 to 4 feet, this material, in turn, is underlain by weathered sandstone, shaly sandstone, or fine-grained sandy shale. In places broken fragments of sandstone lie within 2 feet of the surface, and in other places the parent material lies several feet below. The subsoil in such places is very heavy, but it is not a claypan. In places some black concretions and slightly gray, bright-yellow, and rusty-brown mottlings are present in the lower part of the subsoil.

This soil occurs in large areas throughout the central and western parts of the county, and a few small areas lie east of Neosho River.

The relief is undulating or very gently rolling, and drainage is good, both from the surface and internally. This soil is closely associated with Parsons silt loam which occupies the less sloping positions and has poorer drainage. The Bates soil, where unprotected, is subject to severe washing, and gullies form quickly in some cultivated fields.

The native vegetation is composed largely of the coarse bunch grasses—mainly species of *Andropogon* and *Panicum*.

Probably more than one-half of this soil is in cultivation, as it is well esteemed by farmers. Where not cultivated it is used for pasture and for the production of native-grass hay. The soil has an acid reaction and is low in content of phosphorus. Crop yields are increased by the use of phosphatic fertilizers. Farmers report that the use of phosphatic fertilizer at the rate of 400 pounds an acre has increased wheat yields at the rate of 3 to 5 bushels an acre.

The principal crops are corn, grain sorghums, and cotton. Comparatively small acreages are devoted to oats and wheat. On many farms, much of the land is used for the production of prairie-grass hay. The bluestems (*Andropogon* sp.) are the chief grasses. According to statements of farmers, the acre yields in normal seasons are about as follows: Corn from 15 to 20 bushels, cotton one-third to one-half bale, grain sorghums about the same as corn, but a little more in dry seasons, oats 25 bushels, wheat 15 bushels, and soybeans 10 bushels.

Bates fine sandy loam.—The topsoil of Bates fine sandy loam is brown fine sandy loam about 10 inches thick, which grades below into yellow or yellowish-brown very friable and crumbly fine sandy loam or fine sandy clay. This material, in turn, grades into disintegrated sandstone or shaly sandstone at a depth ranging from 18 to 40 inches. The lower part of the subsoil is splotched with red and gray.

The relief is undulating or gently rolling, and the land has good surface drainage and internal drainage. Although the subsoil is rather freely permeable, it retains moisture well. This is a Prairie soil and supports a heavy growth of the bluestems and other bunch grasses. In places there is a scattered growth of post oak trees.

This soil occurs in many areas, good sized and small, in association with Bates very fine sandy loam and other Prairie soils. It seems to have developed more largely from siliceous parent material and less from shaly material than the heavier soils.

About the same proportion or slightly less of the land is in cultivation than of Bates very fine sandy loam. Crops on this soil require somewhat more moisture than those on Bates very fine sandy loam, and in dry seasons or in normal seasons yields are slightly lower than on the heavier soil. The same crops are grown and slightly lower yields are obtained, as a rule, than on Bates very fine sandy loam. Fruits, berries, and vegetables grow and produce well.

Summit silty clay loam.—Summit silty clay loam consists of very dark brown or black silty clay loam to a depth of about 12 inches. On drying thoroughly the topmost soil material is dark grayish brown. The topsoil grades into brown crumbly and granular silty clay loam, and this, in turn, passes, at a depth ranging from 16 to 20 inches, into yellow or olive-brown heavy but crumbly clay which rests on platy gypsiferous shale at a depth between 3 and 4 feet. The soil is not highly acid in reaction, and the lower part of the subsoil is calcareous in places.

This is a Prairie soil which supports a native vegetation of bunch grasses and some short grasses. It is fairly extensive and occurs in a number of fairly large and some small areas extending almost across the central part of the county from the northern boundary. The relief ranges from undulating to rolling, and the land is well drained.

Probably from 60 to 70 percent of the land is in cultivation, as it is productive and suited to many crops. The crops grown consist largely of corn, with smaller acreages devoted to grain sorghums, oats, wheat, alfalfa, and sweetclover. Corn yields range from 20 to 30 bushels an acre. Yields of cotton average one-half bale, oats 25 bushels, and wheat about 15 bushels. Approximately 1 ton of alfalfa is produced at a cutting, when moisture conditions are favorable. The soil, although heavy, is readily cultivated and works into a pulverulent seedbed if plowed under proper moisture conditions.

Summit very fine sandy loam.—Summit very fine sandy loam comprises slopes or small low areas of Summit silty clay loam, onto which sandy materials have been washed from higher adjoining slopes of sandy soils. It is of small extent. It differs little in character from Summit silty clay loam, except that it contains a little sandy material.

The land is well drained and, owing to the moderately steep slopes on which it occurs, is subject to erosion where unprotected. It is suited to about the same crops, with practically the same yields, as Summit silty clay loam.

Labette silt loam.—The 8-inch topsoil of Labette silt loam is dark-brown silt loam having a smooth friable consistence that indicates a granular structure. It grades into brown or reddish-brown heavy silt loam or clay loam, which gradually becomes heavier with increase in depth. At a depth ranging from 16 to 20 inches, the material is reddish-brown silty clay or clay, and this, at a depth ranging from 2 to 3 feet, changes to grayish-brown clay which merges, at

a depth between 3 and 4 feet, with a bed of calcareous shale or limestone.

The relief is undulating or gently rolling, and drainage is good. This is a Prairie soil covered with native grasses, largely bluestems.

This is not an extensive soil. It occurs in many scattered areas on the high prairies paralleling the west side of Neosho River. The largest areas are around Mayes School west of Salina.

A very large proportion of the land is in cultivation, and the rest is used for pasture. The principal crops are corn, which yields from 15 to 20 bushels an acre, oats 20 to 30 bushels, wheat 15 bushels, grain sorghums about 20 bushels, and cotton one-third bale.

Newtonia very fine sandy loam.—Newtonia very fine sandy loam has a reddish-brown very fine sandy loam 6-inch surface layer underlain by brownish-red clay loam or sandy clay, and this, at a depth ranging from 14 to 20 inches, grades into bright-red crumbly clay. This material becomes yellowish red with increase in depth and rests on a limestone bed or calcareous shale at a depth ranging from 3 to 6 feet.

This soil occurs in one small area about 1 mile north of Pensacola in the northern part of the county. The relief is undulating, and the land has good drainage. It is cultivated to the general farm crops, with yields about the same as those obtained on Labette silt loam. It seems to be a good soil for some truck crops and fruits.

LIGHT-BROWN OR GRAYISH-BROWN SOILS WITH DENSE SUBSOILS

The group of light-brown or grayish-brown soils with dense subsoils includes Parsons silt loam, Cherokee silt loam, Woodson silty clay loam, Craig silt loam, Lebanon very fine sandy loam, and Lebanon very fine sandy loam, shallow phase. The combined area of the soils of this group is 211.2 square miles, or 31.2 percent of the total area of the county.

This grouping is based largely on the common feature of tough dense subsoils, most of which are claypans, although in Craig silt loam and in the Lebanon soils the cemented coarse hard material of the subsoil is true hardpan. The topmost material of the soils of this group dries to a very light gray color. The soils absorb water slowly, owing to the dense subsoils, and in periods of dry weather they dry rapidly and thoroughly, and, as a rule, are of such unfavorable moisture-holding capacity as to be considered droughty, although they are soggy and wet for long periods in wet seasons and during the winter. The relief in general is smooth and nearly flat, but water does not stand on the surface very long after rains. These soils are only moderately well supplied with available plant nutrients, and some are reported to be very low in organic matter and phosphorus; hence they are of only moderate productiveness and have a limited range of suitability for crops. They are somewhat better suited for small grains, grain sorghums, and in some places for fruits, than for corn, alfalfa, and clover. With the exception of the Lebanon soils, which occur on the smooth plateau areas of the Ozark section, these are Prairie soils. The Parsons soils are extensively developed throughout the prairie section, but the other soils are of small extent and occur in scattered small areas.

Parsons silt loam.—The 8-inch topsoil of Parsons silt loam is grayish-brown silt loam containing a large quantity of very fine sand. When moist it is fairly dark, but, on thoroughly drying, it is light grayish brown. It merges below with lighter colored slightly heavier material, light grayish-brown or yellowish-brown silt loam or very heavy very fine sandy loam, which, on drying is very light in color, especially in the lower part of the layer. At a depth ranging from 14 to 18 inches this material changes abruptly to dense waxy yellow, brown, or yellowish-brown clay containing some fine mottlings of gray and splotches of rust brown. This is the claypan which, when dry, is very tough and hard. Water passes through it very slowly. Fine black concretions occur in the subsoil below a depth of 30 inches, and the gray mottled color increases below this depth. A partly weathered shale bed lies several feet beneath the surface, in most places at a depth of more than 3 feet. Soft gypsum crystals occur in many places below a depth ranging from 2 to 3 feet.

Parsons silt loam occupies comparatively large areas in the western two-thirds of the county, and only a few areas are mapped east of Neosho River. It occurs mainly as large connected bodies of undulating or nearly flat smooth prairie land with moderately rapid surface drainage. It is associated chiefly with the Bates and Cherokee soils.

The Parsons soils cover a large total area in southeastern Kansas and northeastern Oklahoma. In Kansas the dominant soil is of heavy silt loam texture in the surface soil and has a very heavy clay subsoil, but toward the south the content of very fine sand increases, and in Craig County, Okla., the surface soil is a well-defined silt loam which contains more very fine sand than the Parsons soil in Labette County, Kans. In Mayes County the content of very fine sand is still greater than in Craig County and is sufficient to convert the surface soil into heavy very fine sandy loam. The soil could be mapped as a very fine sandy loam without serious error. The claypan also is more sandy than the corresponding layer of the Parsons soils in Kansas, but it is hard and sufficiently heavy to constitute a well-defined claypan. The claypan in Kansas is dark, but in Mayes County it is brown and the surface soil is dark brown. The dense claypan subsoil causes very slow internal drainage, and therefore the topsoil and subsoil remain moist late in the spring but become very dry in summer.

Probably one-half of this land, or more, is in cultivation, chiefly to the general farm crops. Farmers report that this soil is better suited to such shallow-rooted crops as small grains, especially oats and wheat, than to corn and deep-rooted crops. Because of their early maturity, crop injury to small grains is avoided, but injury to later maturing crops, as corn, in the hot dry periods of early summer is of frequent occurrence. The land not cultivated is used for pasture and hay which is made from the heavy growth of coarse bunch grasses, chiefly bluestems.

Reports of farmers indicate that acre yields of crops are as follows: Corn 15 to 20 bushels, oats 20 to 30 bushels, wheat 12 to 15 bushels, and cotton one-fourth to one-third bale. Grain sorghums yield about the same quantity of grain as does corn.

This soil is low in nitrogen and phosphorus, and crops respond well to barnyard manure and to commercial fertilizers which have a high content of phosphorus.

Although vegetables and fruits are grown in a small way in the home gardens and small orchards, they do not produce especially well, as the soil dries out late in spring and becomes very dry in summer.

Both the surface soil and subsoil are of acid reaction and this condition, together with the low inherent fertility, poor drainage, and dense, almost impervious claypan, renders the land unsuited to alfalfa and clovers, although fair yields of alfalfa have been obtained in well-drained locations where lime has been applied to neutralize the acidity of the soil.

Cherokee silt loam.—Cherokee silt loam occurs in a number of small flat areas on the prairies and is closely associated with Parsons silt loam. Although it is a Prairie soil developed largely from the same parent materials as Parsons silt loam, it has a flatter surface and, owing to the almost impervious claypan subsoil, is more poorly drained. The topsoil and subsurface layer are lighter in color than the corresponding layers of the Parsons soil.

The topsoil of Cherokee silt loam is gray or grayish-brown silt loam ranging from 4 to 8 inches in thickness and containing sufficient very fine sand in places to be almost a very fine sandy loam. The topsoil, when moist, is rather dark, but when thoroughly dry it is very light colored. This layer grades below into a lighter colored layer of light-textured gray silt loam containing considerable very fine sand. This layer is several inches thick, and the lower part is especially light in color. At a depth ranging from 12 to 18 inches, this material rests on a dense claypan consisting of yellow dense waxy clay which, when dry, is very tough. Below a depth of about 24 inches the claypan contains some gray mottlings which become larger with increase in depth. In places the mottlings are near the top of the claypan, and the material contains much gray color below a depth of 2 feet.

This is a flat Prairie soil of small extent. It has very poor surface drainage and very deficient underdrainage because of the dense claypan. It is developed from shale which lies at a depth of 4 feet or more.

Probably not more than one-fourth of the land is cultivated, but the virgin soil is used for pasture and for prairie hay which produces from one-half to 1 ton an acre. This soil is more poorly drained than Parsons silt loam and seems to contain less organic matter. Inherently it is less fertile than the Parsons soil. The same crops are grown, but yields are slightly lower than on that soil. The same methods of improvement apply to Cherokee silt loam as to Parsons silt loam.

According to one farmer, who has cultivated this soil for several years, corn yields from 10 to 30 bushels an acre. In eight corn crops, an acre yield of 30 bushels was obtained in 1 year, and in 3 of the years only about 10 bushels an acre were produced. Grain sorghums produced 20 bushels or slightly more. Wheat on unfertilized soil was reported to yield from 8 to 10 bushels and where fertilized about 15 bushels, and oats produced from 20 to 30 bushels.

Table 4 gives the results of mechanical analyses of samples of the surface soil, subsurface soil, and subsoil of Cherokee silt loam.

TABLE 4.—*Mechanical analyses of Cherokee silt loam*

Sample no.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
452155	Surface soil, 0 to 3 inches	0.1	0.5	1.1	7.6	9.9	64.7	16.1
452156	Subsurface soil, 3 to 12 inches	.3	1.0	1.5	9.0	9.3	63.0	15.8
452157	Subsoil, 12 to 40 inches	.1	.2	.6	4.2	5.3	42.0	47.5

Woodson silty clay loam.—The topsoil of Woodson silty clay loam is dark-brown or dark grayish-brown silty clay loam about 10 inches thick, and below this is brown or grayish-brown clay loam or clay, which, at a depth ranging from 15 to 18 inches, grades through a short transitional layer into brown or brown and yellow mottled dense waxy clay of claypan characteristics. The claypan gradually becomes solid yellow with increase in depth, and it contains some particles of calcium carbonate and calcium sulphate in the deeper part of the subsoil. It is underlain by limestone or calcareous shale at a depth of several feet.

Woodson silty clay loam is not extensive. It occurs in a number of small areas in the prairies a few miles west of Neosho River Valley. The land is nearly flat, and drainage is poor. Although closely associated with the Summit soils and probably developed largely from the same kind of parent materials, it is somewhat less productive than Summit silty clay loam. About the same crops are grown and approximately the same yields are obtained as on Parsons silt loam. Probably less than one-half of this soil is cultivated, and the rest is used for pasture and hay.

Craig silt loam.—The 8-inch surface layer of Craig silt loam is grayish-brown silt loam. It grades into lighter colored grayish-brown clay containing some chert fragments, and this, at a depth ranging from 14 to 20 inches, rests on a compact hard mass of small angular chert fragments cemented in yellow clay which contains gray and brown spots and some dark iron stains intermingled with the yellow color. In places deeply weathered limestone may occur beneath the surface, but this soil seems to be developed largely from cherty soil materials associated with the Ozark region. In places the soil material just above the hardpan consists of a dense claypan layer 12 or 15 inches thick, and here the hardpan lies from 2 to 3 feet beneath the surface. Some small areas have a few small chert fragments scattered on the surface.

This is a Prairie soil of moderate extent, occupying a total area of 36.7 square miles. It occurs in a number of bodies in the eastern half of the county. The largest areas are northeast of Pensacola, along the western edge of Neosho River Valley, and in the vicinity and east of Locust Grove. In most places it is associated with the limestone soils but lies near the Ozark hills. The relief is undulating, and surface drainage is good, but underdrainage is slow. The land is subject to erosion where unprotected.

Farmers state that grapes and several other fruits do fairly well. Probably more than one-half of the land is in cultivation, and the general farm crops of the section are grown. According to the farmers, acre yields are about as follows: Cotton one-fourth to one-half bale, corn 15 bushels, wheat 8 bushels, and grain sorghums from 10 to 15 bushels. This is considered a fairly good soil. It is acid in reaction and probably would respond to applications of barnyard manure and phosphatic fertilizers.

Lebanon very fine sandy loam.—Lebanon very fine sandy loam is a forest soil of the smooth nearly flat high plateaus of the Ozark section. It has a typical hardpan developed from cherty limestone, the limestone having weathered and leached away, leaving the small angular chert fragments in beds lying from 1 to more than 2 feet beneath the surface.

The 2-inch surface layer of this soil, in the virgin state, is light-brown very fine sandy loam. This thin layer contains slightly decayed organic matter consisting largely of forest debris and leafmold. Below this is a layer of yellow or grayish-yellow very fine sandy loam which contains some splotches of rusty brown. This layer extends to a depth ranging from 18 to 24 inches and rests on dense mottled yellow and gray clay, and this, between depths of 20 and 30 inches, is underlain by a cemented hard mass of fine and small subangular chert fragments embedded in mottled gray and yellow clay containing some red splotches. In places the topsoil is very heavy and silty, and below a depth of several inches it is clay loam. In some places the second layer rests on the hardpan with no intervening clay layer. This soil remains very wet throughout the winter and spring and dries to a very hard mass in the summer.

The land, where uncleared, supports a native vegetation chiefly of oak trees, in which post oak and blackjack oak predominate.

The soil is of acid reaction. It is low in organic matter and in some of the essential plant nutrients.

The relief is smooth, and drainage is poor. This is not an extensive soil. It occurs in numerous bodies, some of which cover several hundred acres, in the Ozark section in the eastern part of the county.

Little of the land is cultivated, as it is not highly productive and crops suffer quickly from droughty conditions. Some of the general farm crops are grown, and farmers report acre yields to be about as follows: Corn from 4 to 10 bushels, cotton one-eighth bale, and grain sorghums from 8 to 15 bushels.

Lebanon very fine sandy loam, shallow phase.—The shallow phase of Lebanon very fine sandy loam is similar to the typical soil, both in soil characteristics and in crop adaptation. It occurs in association with the typical soil on the more rolling areas of the smooth divides in the Ozark section. The soil layers are thinner above the hardpan, and they contain more chert fragments than the typical soil.

Grapes, orchard fruits, and berries grow fairly well and are produced to some extent. Orchard trees are reported to be short-lived. Farm crops do not yield so well as they do on the typical soil. Therefore this shallow soil may be considered distinctly marginal for the general farm crops.

Soil of this phase is fairly extensive. It occurs in a number of fairly large areas in the eastern part of the county in association with the typical soil and other soils of the Ozark section. The forest growth is practically the same as that on the typical soil. Little of the land is cultivated.

LIGHT-TEXTURED VERY PERMEABLE UPLAND SOILS

The group of light-textured very permeable upland soils is comprised of a few widely separated soils which, owing to certain physical characteristics and to characteristics of the substrata, are well drained and rather severely leached. Although these soils are low in inherent fertility, they respond well to such soil-improvement practices as fertilization, addition of organic matter, and various other practical methods of conserving and increasing the native fertility. These soils produce only moderate or low yields of farm crops. Some of them are well suited to fruits, berries, and vegetables, although some are too porous to produce good yields of any crop. These soils include Hanceville fine sandy loam, Bates fine sandy loam, shallow phase, Riverton very fine sandy loam, and Riverton very fine sandy loam, high-terrace phase. Their combined area covers 55.6 square miles, or 8.2 percent of the total area of the county.

The Hanceville soils comprise forested rolling soils developed from sandstone; the Bates soils are smooth Prairie soils developed from sandstone and shale beds; and the Riverton soils consist of smooth shallow soils developed over beds of gravel on ancient stream terraces, comprising soil materials washed largely from soils of the eastern prairies.

Hanceville fine sandy loam.—The 2- or 3-inch topsoil of Hanceville fine sandy loam (in virgin areas) is brown or grayish-brown fine sandy loam. It grades into yellow or reddish-yellow fine sandy loam which extends to a depth ranging from 12 to 18 inches, where it merges, through a transitional zone, with red friable sandy clay. The red clay subsoil grades into disintegrated soft sandstone between depths of 3 and 4 feet, and in places at a somewhat greater depth. The lower part of the subsoil, just above the sandstone, is somewhat yellow and in places contains some gray spots and streaks. Fine and small sandstone fragments occur in small quantities throughout the surface soil and subsoil. In cultivated areas the grayish-brown surface layer is 6 or 8 inches thick, due to the incorporation of organic matter into the subsurface layer. In many areas of this soil, the material in the surface and subsurface layers is very light in texture, and in some places it is loamy fine sand. In places the topsoil layers are red, in other places the fine sandy clay subsoil is yellow, and in some shallow marginal areas the stony parent material lies within a depth ranging from 12 to 18 inches. Owing to the slight extent of these areas, they were not mapped separately.

Hanceville fine sandy loam occurs in a number of small areas widely scattered through the northwestern and southern parts of the county. Most of these occupy the smooth high divides or ridges of sandstone from which the soil has developed.

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This soil is forested mainly with post oak, blackjack oak, and some hickory. Probably more than 60 percent of the land is in cultivation. The soil is acid in reaction, contains little organic matter, and inherently is low in some of the essential plant nutrients. It is especially suited to fruits, grapes, berries, and vegetables.

Although this soil has excellent or rather excessive underdrainage, depending on the thickness of the sandy clay layer above the parent rock, it is, where deeply developed, a soil which holds moisture well and which may be termed fairly drought resistant. The soil is easy to cultivate and responds well to fertilization and to the incorporation of barnyard manure and organic matter. It is used chiefly for the production of the general farm crops, especially cotton and some corn and sorghums. Some fruits and truck crops are produced for local markets. Yields depend largely on the care that has been given in improving the soil. Farmers report that in favorable seasons sweetpotatoes yield 200 or 250 bushels an acre, and potatoes from 50 to 75 bushels. On the unfertilized soil, acre yields of corn range from 5 to 15 bushels, grain sorghums 10 to 20 bushels, and cotton one-sixth to one-third bale.

This soil erodes readily where unprotected, and when farmed without the use of fertilizers or the incorporation of organic matter the productivity rapidly diminishes. Terracing, growing peas, plowing under organic matter of any kind, preferably crop residues, and using commercial fertilizers cause the soil to produce well. The land is better suited to the production of vegetables, fruits, berries, peas, and peanuts than to the general farm crops. It is recognized as being entirely unsuited to small grains.

Bates fine sandy loam, shallow phase.—Bates fine sandy loam, shallow phase, is a shallow Prairie soil of moderate extent. It occurs in many small areas well scattered throughout all parts of the prairie section in the western half of the county, in close association with the typical soil.

The topsoil is brown fine sandy loam about 10 inches thick. It is underlain by yellow or reddish-brown fine sandy loam or sandy clay, which in places in the lower part of the horizon contains some splotches and mottlings of gray, rusty-brown, and red material. Below this, at a depth ranging from 12 to 18 inches, the material grades into disintegrated sandstone fragments and, in places, some shaly material. In places the topsoil rests on the broken rock material, and some stony material lies on the surface and throughout the soil mass.

This is a thin Prairie soil which supports some scattered shrubs and small trees, mainly persimmon, sassafras, and in places a few post oaks.

This soil is porous and leachy and is generally considered of little value for cultivated crops. It is used chiefly for grazing, as it supports a growth of coarse bluestem grasses and other bunch grasses. The relief ranges from undulating to sloping, and, where unprotected by vegetation, the soil on the slopes rapidly washes away. Though sufficiently smooth for cultivation, its low productive capacity for practically all farm crops renders this soil unsuited for any purpose other than grazing. Probably some areas would produce fair yields of grapes, berries, and some vegetables, if the land were

properly cared for, but, on the whole, the land may be considered submarginal for cultivated crops.

Riverton very fine sandy loam.—The 8- or 10-inch surface soil of Riverton very fine sandy loam is grayish-brown very fine sandy loam, which grades into reddish-brown loam or heavy very fine sandy loam. At a depth ranging from 16 to 20 inches, this passes into reddish-brown or yellowish-red fine sandy clay or fine sandy clay loam, and this layer, in turn, rests on a bed of rounded gravel at a depth ranging from 2 to 4 feet. The gravel consist mainly of small well-rounded pieces of chert and quartzite, in places embedded in red sandy clay, whereas in other places the fine-earth content is very small. In places the gravelly material lies within 12 inches of the surface. The underlying gravel is used locally to considerable extent as road-surfacing material.

This soil occupies a number of areas on terraces of ancient alluvium along the borders and high above the present flood plain of Neosho River and some of its tributary streams.

Much of the land is in cultivation, and where not cultivated, it is forested, chiefly with oak, elm, shittim wood, and other trees. This is considered a droughty soil because of the porous leachy character of the underlying substratum. It yields fairly well when moisture conditions are satisfactory, but, on the whole, it is not highly productive. The land is easily cultivated, but it erodes readily on unprotected slopes. The principal crops grown are corn, cotton, and sorghums, and a small acreage is devoted to small grains. This soil is fairly well suited to vegetables and fruits, and, probably, in spots where deep soil layers are developed over the gravel beds, it is fairly productive.

Riverton very fine sandy loam, high-terrace phase.—The high-terrace phase of Riverton very fine sandy loam differs from the typical soil in that the underlying gravel beds are somewhat cemented, and in places a slightly developed hardpan has developed. This soil occurs on high more or less eroded land, at about the same level as the adjacent prairie uplands. The relief is in general rolling, as the soil occupies remnants of old high and formerly more extensive terraces which have been largely removed by erosion. About the same crops are grown as on the typical soil, and for the most part crop yields are approximately the same.

WELL-DRAINED ALLUVIAL SOILS

The group of well-drained alluvial soils includes Verdigris very fine sandy loam, Verdigris silt loam, Verdigris silty clay loam, and Huntington gravelly silt loam. The combined area of these soils is 52.8 square miles, or 7.8 percent of the total area of the county. These soils occur in the flood plains along Neosho River and a number of the larger creeks in the prairie section of the county. They consist of materials washed mostly from the soils of the prairies of eastern Kansas and Oklahoma, and very largely from the dark Prairie soils of the Bates, Parsons, and Summit series. These soils are deep, readily permeable, and retain moisture well. They hold a good supply of available moisture well into periods of light rainfall, thereby affording very favorable moisture conditions when the Prairie and other upland soils are very dry and crops on them are suffering from lack of moisture. These soils are overflowed occa-

sionally, but only for short periods, and they dry rapidly. Now and then crops are injured or destroyed by overflows, but, as a rule, complete crop losses are rare. The surface soils are brown, and the subsoils are brown or yellowish brown, crumbly, and friable.

These soils are very productive, and practically all the land occupied by them is in cultivation. They are the best soils in this county for growing corn and feed crops because of their excellent moisture conditions and their inherent fertility. They are very slightly acid or neutral in reaction.

These soils originally were covered with a rather heavy growth of trees, nearly all of which has been cleared from the land, although some pecans, elms, and sycamores are still growing in places, mainly along the stream banks. Other trees that probably were abundant at one time are species of oak, hackberry, walnut, cottonwood, and others. These soils are excellent for pecan trees.

Verdigris silt loam.—Verdigris silt loam is the most extensive alluvial soil. It occupies a total area of 34.2 square miles. It comprises a number of areas on the first bottoms along Neosho River and the larger creeks. The relief is nearly flat, but the land has good surface drainage and underdrainage. It has excellent water-holding capacity which enables crops to withstand droughty conditions.

The 6- or 8-inch surface layer is brown silt loam which grades into a subsurface layer of yellowish-brown or brownish-yellow friable and crumbly silt loam or silty clay loam. This material, in turn, grades, at a depth ranging from 12 to 18 inches, into grayish-yellow clay containing slight mottlings of gray and red. The soil, in places, contains considerable very fine sand and fine sand at a depth ranging from 24 to 30 inches. A few areas, too small to separate on the map, are underlain by a bed of small gravel, and this causes the soil to be more thoroughly drained and less valuable for crops.

Most of the land is cultivated. It is a highly desirable soil, and, probably, is the most productive one in the county. It is very good for corn and alfalfa. Much corn but only a small amount of alfalfa are grown. Other crops are cotton, grain sorghums, and several others. According to local reports, acre yields of corn range from 25 to 35 bushels, and in some years from 50 to 60 bushels; cotton one-half to three-fourths bale; oats, which are grown on only small acreages, about 30 bushels; and wheat 15 to 20 bushels.

Verdigris very fine sandy loam.—Verdigris very fine sandy loam is less extensive than Verdigris silt loam. It occurs in widely scattered small areas throughout the bottom lands along Neosho River and the larger creeks. The largest bodies are along Pryor Creek in the northwestern part of the county.

Verdigris very fine sandy loam consists of brown very fine sandy loam to a depth of about 8 inches. This material grades into yellowish-brown sandy clay loam which, with increase in depth, becomes yellow sandy clay. At a depth of several feet are beds of sandy alluvium. In places sandy layers occur at a depth ranging from 2 to 3 feet.

The relief is smooth, and drainage is good, but water from the occasional overflows remains on the surface for short periods.

Practically all the land is in cultivation, and the chief crops are corn, cotton, small amounts of alfalfa, and in places some oats and

grain sorghums. Most of this soil is used for corn which yields from 20 to 25 bushels an acre, and in some years 50 or more bushels may be obtained. Cotton yields well and produces from one-half to three-fourths bale. Alfalfa makes good growth and yields well.

Verdigris silty clay loam.—Verdigris silty clay loam occurs principally along Pryor Creek, and some areas are on the bottom land along Neosho River. It is of very small extent.

The topsoil is grayish-brown silty clay loam about 6 inches thick, which is underlain by yellowish-brown silty clay loam, and this, at a depth ranging from 12 to 18 inches, grades into brown or grayish-yellow clay containing slight mottlings of gray and rusty brown.

The land is cultivated to some extent, and in places it remains forested. The relief is flat, and drainage is slower than from the other Verdigris soils. The crops grown and average yields obtained are about the same as on Verdigris silt loam. In well-drained positions, yields of crops may be higher in some years, and in low positions where drainage is slow the yields may be somewhat lower than on the silt loam.

Huntington gravelly silt loam.—Huntington gravelly silt loam is a dark soil occurring only as narrow strips of first bottom land along the small streams of the Ozark section.

This soil has a dark-brown or grayish-brown silt loam surface layer containing considerable angular and rounded chert gravel, which passes, at a depth of 6 or 8 inches, into yellowish-brown gravelly silt loam. This changes to heavier material with increase in depth, and, below a depth ranging from 14 to 18 inches, it is yellow gravelly clay loam. The gravel content of the surface soil and subsoil constitutes about 75 percent of the total mass of all the soil layers. This is a good soil but little of it is cultivated. Most of it remains in forest, chiefly of white, red, and bur oaks, hickory, ash, elm, and sycamore.

Although fertile and well suited to several crops, this soil is difficult to cultivate because of the gravel content. It is neutral or acid in reaction. Small acreages are used for corn, clover, alfalfa, and vegetables, and yields are fairly good on the smooth and less gravelly areas.

IMPERFECTLY DRAINED ALLUVIAL SOILS

Only two soils—Lightning silt loam and Lightning silty clay loam—are mapped in the group of imperfectly drained alluvial soils in Mayes County, and these are inextensive. The surface soils are gray or grayish brown, and the subsoils are gray, more or less splotched and mottled. Surface drainage is slow, and underdrainage is imperfect. The land remains wet a long time after rains and during the winter. These soils are developed from soil materials washed from the dark soils of the nearby prairies. Most of the areas are in the prairie section along Pryor Creek, and small areas lie along some of the other creeks. Poor drainage prevents satisfactory production of crops in many places, and only small areas are cultivated.

Lightning silt loam.—The 6-inch topsoil of Lightning silt loam consists of grayish-brown silt loam. This grades into yellow, grayish-yellow, or grayish-brown silt loam or silty clay loam, which, at a depth ranging from 12 to 18 inches, grades through a very thin transitional layer into gray or grayish-yellow heavy clay containing

slight mottlings of yellow and brown. This layer, which extends to a depth of several feet, is a partly developed claypan.

Owing to slow underdrainage and surface drainage and probably to overflows, this soil is not cultivated very extensively. It is nowhere heavily forested, and in places no trees grow on the virgin soil. Some of the land is in cultivation, and the principal crops are corn, sorghums, and small grains. According to local information, crop yields are about the same as those obtained on Parsons silt loam.

Lightning silty clay loam.—Lightning silty clay loam consists of gray or grayish-brown silty clay loam to a depth of about 15 or 18 inches. The upper 6 inches of material are slightly darker than the material below. The underlying material is heavy gray clay which contains rusty-brown and yellowish-brown splotches and mottlings and extends to a depth of several feet. The relief is flat, and drainage is poor.

Some virgin areas support only a few trees, and in places some oaks, elm, and hackberry grow. This is not an extensive soil. A number of small areas occur for a distance of several miles along Pryor Creek north of Pryor and in a few places along other creeks in the prairie section.

Little of the land is farmed, probably because of poor drainage. The farmers state that small areas have been drained and are producing fair crops of corn, grain sorghums, and small grains.

NONARABLE SOILS AND ROUGH LANDS

The group of nonarable soils and rough lands comprises land which cannot be cultivated because of the stoniness of both surface soil and subsoil. Most of the loose stones are small and can be readily lifted and hauled from the land, but the soils are so shallow that they are unsuited for cultivation, even in places where the stony material has been removed from the surface. The stony soils have fairly smooth and moderate slopes in places, in contrast to the rough precipitous slopes of the rough stony land. Large boulders and rocks outcrop on the surface, which result in such a rough and stony condition that no possible use of the land for cultivated crops could be attempted. Most of these stony soils and rough land are forested, and their only agricultural use is for the scant grazing afforded by the thin growth of grasses, and for growing trees, although the native trees, for the most part, are suited only for firewood, posts, and rough timbers.

The soils included in this group are Summit stony clay loam, Eldorado stony clay loam, Hanceville stony loam, Okoee stony loam, rough stony land (Hanceville soil material), and rough stony land (Leslie soil material).

Summit stony clay loam.—The fine-earth material of Summit stony clay loam is black crumbly calcareous clay loam which, on drying, breaks down naturally into coarse and fine grains. At a depth of 6 or 8 inches, this material grades into yellow or mottled yellow and brown waxy clay which is calcareous but not granular. Large quantities of small broken limestone fragments occur on the surface and throughout the surface soil and subsoil. At a depth ranging from a few inches to a few feet, the stony soil material rests on loose broken fragments of limestone or beds of solid lime-

stone slabs. In places the soil is slightly acid or neutral, and in other places it is calcareous.

This soil is of small extent. It occurs in small widely scattered rolling areas throughout the central limestone strip extending from north to south through the county and is most extensive southeast of Pryor. The native grasses on this soil are largely bluestems and gramas, which afford excellent pasture for livestock. As the soil is too stony for cultivation, its best use is for pasture.

Eldorado stony clay loam.—Eldorado stony clay loam consists of dark-brown clay loam containing many chert fragments several inches thick. The surface soil of stony fine-earth material is only a few inches thick, and it rests on beds of chert and limestone. This is a Prairie soil occupying ridges and moderate slopes. The native vegetation consists of coarse bunch grasses, and the only present use for the land is for pasturing livestock. This soil is of very small extent. It occurs in a few small areas on the prairies west of Neosho River between Strang and Locust Grove.

Hanceville stony loam.—The 2- or 3-inch surface layer of Hanceville stony loam consists of grayish-brown or reddish-brown fine sandy loam. It grades into yellow, yellowish-brown, or reddish-brown fine sandy loam which, at a depth ranging from 10 to 18 inches, is underlain by disintegrated sandstone. In places, there is a transitional layer of red fine sandy clay between the fine sandy loam and the soft crumbly sandstone which continues to a depth ranging from 2 to 3 feet. In places the soft broken sandstone rock bed lies very near the surface, and the only fine-earth material is a small quantity of brown or yellow fine sand. Strewn over the surface and throughout the soil mass are many fragments of sandstone, which, in places, are highly ferruginous.

This soil occurs in a number of fair-sized areas on the sandstone ridges of the northwestern part of the county, where it is associated with other sandstone soils of the Hanceville and Bates series.

In places some good-sized areas of Bates stony fine sandy loam are included in mapping. This soil is very similar to Hanceville stony loam, but it is a Prairie soil and has a dark topsoil. It is developed on sandstone ridges in topographic positions similar to those occupied by Hanceville stony loam.

The relief of Hanceville stony loam ranges from rolling to hilly, and some slopes are very steep. Post oak, blackjack oak, and hickory are the principal trees. The soil is too stony and thin for cultivation, even in the smoother areas, and it is best suited for forestry and for pasture. Where cleared of trees the land supports a heavy growth of coarse bunch grasses, mainly species of *Andropogon*. On the smoother areas, grapes, berries, and some small fruits might be grown.

Okoee stony loam.—Okoee stony loam occupies large areas in the eastern part of the county and covers a total area of 93.9 square miles. It has developed from material accumulated by the decay in place of cherty limestones. The areas are not uniform in character, but they are dominantly Okoee stony loam and include smaller areas of Clarksville stony loam and Baxter stony loam.

The dominant soil has a 2-inch layer of dark-gray material beneath a thin layer of leafmold. It is underlain by gray or pale-yellow material that may have a maximum thickness of more than 2 feet.

This becomes slightly heavier below a depth of about 1 foot, but, on account of the presence of large quantities of stones, the change in texture is not noticeable. This layer is underlain by rust-brown or slightly reddish brown material containing much cherty material, and this, in turn, at a depth ranging from 5 to 20 feet, by cherty limestone. A large quantity of chert fragments, most of which are less than 4 inches in diameter, are on the surface and throughout the soil mass.

In places the material between depths of 1 foot and 4 feet is slightly red, but it is too pale to be classed as Baxter soil and not yellow enough to be classed as Clarksville. Induration may have taken place in the subsoil but not to sufficient extent for the soil to be classed as Lebanon soil. The Okoee soils are more closely related to the Clarksville than to any other soil. Their identification as members of the Clarksville series would not be wholly wrong, but the surface soil is less gray and the heavier material beneath is less yellow than in the Clarksville soils. Considerable areas of Baxter soils, differing from the Okoee soils in the definite redness of the subsoil, occur within areas mapped as Okoee stony loam; and small areas of a stony soil with a pale-red heavier subsoil and with induration at a depth of about 38 inches, occur on smooth upland areas. These are Lebanon soils.

The relief of Okoee stony loam ranges from rolling to steeply sloping and hilly. The land is forested with several species of oak (largely post oak and blackjack oak), hickory, and some other trees. The soil is too stony and thin for cultivation and is suitable only for forestry and for pasture, and its value for these purposes is low.

Rough stony land (Hanceville soil material).—Rough stony land (Hanceville soil material) includes very steep rough areas of sandstone occurring as ridges, hills, or escarpments. In places the slopes are blufflike and very precipitous. All are covered with massive boulders of sandstone and with rock outcrops, producing a very rough terrain. The small quantity of fine earth is brown fine sandy loam overlying yellow or reddish-yellow fine sandy loam. The land supports a forest growth consisting chiefly of post oak, blackjack oak, and hickory.

Land of this kind occurs in a number of small areas and in some large areas of several hundred acres each in the northwestern part of the county where it forms the steeper rougher slopes of a high escarpment of a broad sandstone ridge. Large bodies are in the south-central part in the hilly rough lands bordering the valley of Neosho River. The land has no use except for forestry and for the scant pasture afforded by a thin growth of coarse grasses.

Rough stony land (Leslie soil material).—Rough stony land (Leslie soil material) consists of steep and moderate slopes covered with massive limestone blocks and outcrops of thick beds of limestone, together with small quantities of dark clay or clay loam between the rocks. The less steep slopes have a gradient of 10 percent or more, and some blufflike areas are very steep. The surface soil is black clay loam, and the subsoil is brown or grayish-brown clay.

This land occurs in a number of areas in the south-central part of the county near the valley of Neosho River. Much of this limestone rough land forms the lower slopes, and on the upper portions

appear the great beds of outcropping sandstone layers which have been classified as rough stony land (Hanceville soil material).

The forest growth is largely hackberry, haw, elm, and various other trees, with some pecan trees on the lower slopes. This land is too rough for cultivation and is suited only for forestry and for pasture. It is not so thickly forested as rough stony land (Hanceville soil material), and the tree growth includes entirely different species.

SOILS AND THEIR INTERPRETATION

Mayes County lies in two definite and distinctive soil regions. These are the Prairies and the stony hilly areas of the Ozark region. The Prairies are covered with a grass vegetation, and the Ozark region is covered with trees. The soils are, therefore, distinctly different in development, as the grass vegetation imparts a dark color to the soils, and the forested soils of slight organic content are light in color. The soils of this particular county do not in all places have the distinctive features of prairie or forest type of development very strongly accentuated. The colors merge gradually in some areas, and in places the change in color from one area to another is abrupt.

The soils have also been influenced in their development by the character of the parent material. The eastern, or Ozark, section is underlain by very cherty limestone. In the forested sections in the western and southern parts of the county, argillaceous shales and sandstones constitute the chief rocks on the surface, but in the southern part some limestone beds outcrop, and these have developed rough forested land. The smooth prairies are composed of soils developed from shales and limestones, with some admixtures of siliceous rocks.

The soils naturally are separated into two broad groups—light-colored soils and dark-colored soils—and each group may be subdivided into well-drained and imperfectly drained soils. The well-drained soils in the Ozark section are classed in the Okoee series, and the imperfectly drained soils of this section in the Lebanon series. The outstanding characteristics of the well-drained soils of the Ozark section are their light color, stony character, and lack of organic matter. The imperfectly drained soils of this section also are light in color but have a very impervious hardpan and are low in organic matter. The well-drained soils have immaturely developed profiles. Broadly speaking, they are A-C soils, in which the surface soil consists of a thin layer of leafmold underlain by a few inches of dark grayish-brown silty material which rests on the partly weathered cherty bedrock.

A description of a typical profile of Okoee stony loam is as follows:

0 to ½ inch, a thin layer of leafmold.
½ inch to 2 inches, light grayish-brown loam.
2 to 10 inches, yellowish-gray or grayish-brown loam which contains some organic matter and many cherty fragments.
10 to 50 inches, typically light-gray, but may range to light rusty brown, cherty clay loam. Where the latter condition exists this soil approaches the Baxter soils in character. The chert fragments range in thickness from about 1 inch to almost a foot and are very numerous.
50 inches +, hard cherty limestone in most places.

The poorly drained soils of this group have passed normal development in that they have an abnormal hardpan, which is the result of excessive moisture, owing to the flat relief. These soils are high in the sesquioxides of iron and alumina.

Following is a description of a typical profile of Lebanon very fine sandy loam, as observed about 200 yards west of the section line of sec. 6, T. 21 N., R. 21 E., on the State highway between Salina and Spavinaw:

0 to 5 inches, grayish-yellow very fine sandy loam which ranges from platy to single grained in structure. The surface of this horizon is covered with a thin layer of leafmold, and it is the darkest horizon in the profile. It becomes much lighter when dry.

5 to 12 inches, yellowish-gray very fine sandy loam splotched and specked with dark brown and red. The structure here is very indefinite.

12 to 38 inches, pale yellowish-gray very fine sandy clay mottled with light gray and dark red. The light gray appears on the outsides and the dark red on the insides of the particles.

38 to 50 inches +, light-gray cherty clay cemented and incrusted with iron and alumina to form a hardpan. The hardpan is friable when broken but is not permeable to water nor affected by it.

This soil remains very soggy and wet during winter and early spring. It is very hard and compact when dry. Surface drainage everywhere is poor, and underdrainage is entirely restricted.

A shallow phase of this soil is mapped, which differs from the typical soil only in degree of development, that is, the hardpan is not quite so well developed, the content of cherty rock is greater, and the rocks are nearer the surface.

The eastern cross timbers section of the county, which includes the forested soils developed from sandstone formations, is very small in extent. The soils here have been divided into two classes—the stony or immature soils and the stone-free more mature soils. The stony soils are represented by Hanceville stony loam and rough stony land (Hanceville soil material) and the more mature soils by Hanceville fine sandy loam. These soils are developed under forest cover and therefore are light in color.

Hanceville stony loam, the immature soil, may be considered an A-C soil, as erosion has prevented deep and normal development. The topsoil of Hanceville stony loam consists of grayish-brown loam about 5 inches thick, on the surface of which is a thin layer of leafmold. This layer rests on the partly weathered and more or less disintegrated sandstone. These imperfectly developed horizons contain many loose fragments of sandstone.

Hanceville fine sandy loam has reached a more advanced stage of development, but in many places erosion has removed the material in the surface layer nearly as rapidly as it has formed. This soil is therefore only partly mature, but it has a definite well-oxidized B layer of illuviated sandy clay. It occurs on the more smooth divides. Following is a description of a typical profile of Hanceville fine sandy loam, as observed along the west side of the road about 800 yards north of the southeast corner of sec. 5, T. 22 N., R. 18 E.

0 to 4 inches, dark grayish-brown fine sandy loam of single-grain structure, containing a small quantity of organic remains.

4 to 18 inches, yellowish-red fine sandy clay softly cubical in structure. The structure is very indefinite. The material in this layer dries to grayish yellow. It has a greasy feel and when crushed is lighter colored.

18 to 34 inches, light brownish-yellow sandy clay containing a large quantity of partly weathered sandstone. This layer rests abruptly on the unweathered yellowish-gray sandstone at a depth of several feet.

The Prairie soils have developed from three distinct formations—limestones and calcareous shales, cherty Mississippian limestone, and the later Pennsylvanian limestones and sandy argillaceous shales. These soils have developed under a grass cover and are dark. Parsons silt loam is an imperfectly drained soil with a heavy claypan subsoil. The surface soil is much lighter in color than that layer of any other Prairie soil, except Cherokee silt loam. The light color is due to slow drainage and podzolization which have removed a large part of the dark organic material.

Following is a description of a typical profile of Parsons silt loam, as observed in a deep-cut bank on the east side of the underpass on United States Highway No. 69 just north of Pryor:

0 to 8 inches, dark grayish-brown very fine sandy loam. The 3-inch surface layer is slightly laminated and contains many fine grass roots, and the material in the lower 5 inches is slightly lighter in color.

8 to 14 inches, light grayish-brown very fine sandy loam which contains much less organic matter than the layer above.

14 to 22 inches, brownish-drab dense columnar clay, of which the color is not uniform but is predominantly dark drab. The structure particles are very dense. The insides of them are yellow or red and the outsides yellowish gray or brown. The material breaks into irregularly angular fragments when dry, but it is very heavy and plastic when wet.

22 to 37 inches, light yellowish-brown dense clay which breaks into irregularly angular clods, and the red splotches gradually change to brownish yellow with increased depth.

37 to 60 inches, yellowish-gray clay which is less compact than the material in the layer above. The material in this layer is mottled with limonite-yellow and rusty-brown specks and stains. The lower part of the layer contains finely disseminated small gypsum crystals.

The Bates soils are dark and belong in the Prairie division of soils. Bates very fine sandy loam has developed from practically the same kind of parent material as has Parsons silt loam. It has developed under better drainage and does not have the dense heavy claypan characteristic of Parsons silt loam. Following is a description of a typical profile of Bates very fine sandy loam, as observed just west of the underpass a few miles north of Pryor on United States Highway No. 69:

0 to 7 inches, dark grayish-brown very fine sandy loam which ranges from single grain to faintly crumblike in structure. The content of organic matter is large, and the soil supports a good sod.

7 to 14 inches, light grayish-brown very fine sandy loam which is faintly granular and contains many worm casts.

14 to 29 inches, yellowish-gray very fine sandy clay which is coarsely granular. The outsides of the granules are yellow heavily coated with gray, and the insides are red or brown. Small fragments of partly weathered shale and ferruginous pellets are present. A sliced surface presents a bright-red, yellow, and dark-brown splotched appearance.

29 to 38 inches, light grayish-yellow sandy clay which is softly columnar to cloddy in structure. The insides of the clods are red or yellow, and the outsides are yellow or gray. The material in this layer is very heavy. The insides of the structure particles are much heavier than the outsides.

38 to 50 inches, gray sandy clay streaked with limonite yellow and rusty brown. This layer rests on the unweathered sandy shale.

Bates fine sandy loam is very similar to Bates very fine sandy loam and is developed, perhaps, from shales containing more sand. The

development of the different horizons is not quite so thick. This soil occurs on more sloping relief, and erosion has removed a part of the surface soil.

The Woodson, Summit, Labette, and Newtonia soils have developed from limestone and calcareous shales. These soils are typical Prairie soils extending in a belt a few miles west of and paralleling Neosho River. The Newtonia and Labette soils are well-drained brown or red soils, and the Summit and Woodson soils are dark and less thoroughly drained. The Summit and Woodson soils have developed from the heavy calcareous shales and limestones and are much heavier and darker than the Labette and Newtonia soils.

Following is a description of a typical profile of Labette silt loam, as observed on the highway east of Pryor about one-fourth mile east of the northwest corner of sec. 18, T. 21 N., R. 20 E.:

0 to 5 inches, laminated or faintly granular dark grayish-brown silt loam, with a good supply of organic matter and containing shotlike ferruginous pellets.

5 to 16 inches, dark grayish-brown granular silt loam. The insides of the soil particles are lighter colored than the outsides. The material in this layer merges gradually with that in the layer below.

16 to 32 inches, coarsely granular reddish-brown silty clay. The granules have waxy surfaces. The insides are rusty brown and the outsides grayish yellow.

32 to 48 inches, grayish-brown clay which is somewhat platy. The material lining the cracks along the platy surfaces is rusty brown. The material in this layer merges below with interbedded calcareous shale and limestone.

Newtonia very fine sandy loam is very similar to the Labette soil, but it does not contain so much organic matter and the second layer is bright red rather than grayish brown. It has a more greasy feel and is perhaps developed from limestone having a comparatively high content of iron.

Following is a description of a typical profile of Woodson silty clay loam, as observed a few miles east of Adair, one-fourth mile east of the northwest corner of sec. 36, T. 23 N., R. 19 E.:

0 to 6 inches, black finely granular silty clay loam which supports a heavy sod.

6 to 14 inches, very dark drab or brown clay loam, in which the granules are larger than those in the layer above and are heavily coated with organic matter.

14 to 26 inches, very dense black or drab columnar clay which is very similar in structure to Parsons claypan and contains small brown pellets. On drying the material breaks into small sharply angular fragments.

26 to 40 inches, drab gypsiferous clay which is not so dense as that in the layer above.

This soil differs from Summit silty clay loam in that it has a fairly well developed claypan.

Following is a description of a typical profile of Summit silty clay loam, as observed about 100 yards south of the northwest corner of sec. 16, T. 22 N., R. 20 E.:

0 to 4 inches, black very finely granular silty clay loam which supports a dense grass sod.

4 to 9 inches, dark grayish-brown granular silty clay loam, in which the granules are larger than those in the layer above.

9 to 16 inches, drab or yellowish-brown clay loam which ranges from coarsely granular to cubical in structure.

16 to 40 inches, bluish-gray waxy clay containing a few concretions of calcium carbonate. The fine earth in this layer does not effervesce with acid.

Craig silt loam is a border-line soil between the two soil provinces. It is developed from cherty Ozark material and is fairly light in color though a Prairie soil. Following is a description of a typical profile of Craig silt loam, as observed about 200 yards south of Military School in the northeast corner of sec. 7, T. 23 N., R. 21 E.:

0 to 5 inches, dark grayish-brown light-textured silt loam or heavy very fine sandy loam, with a crumblike structure and containing an abundance of organic matter.

5 to 13 inches, grayish-brown silt loam, in which the outsides of the soil particles are slightly darker than the insides, and in which small angular cherty fragments are numerous.

13 to 19 inches, pale grayish-yellow silty clay which is specked, splotched, and stained with rust brown and red. The insides of the soil particles are bright red, and the outsides range from yellow to rust brown and gray.

19 to 25 inches, dark grayish-brown or drab heavy clay which breaks into irregularly shaped angular fragments. The insides of the fragments are red and rust brown, and the outsides are dark gray and light gray. This layer rests abruptly on the hardpan.

25 to 40 inches +, cherty ferruginous cemented conglomerate material. This hardpan is impervious to water when undisturbed, but when broken it is very friable.

Riverton very fine sandy loam occurs on an old terracelike formation and seems to occupy two distinct benches. The soil of the older terrace has developed, in places, an incipient hardpan similar to that developed in the Craig and Lebanon soils. This terrace is not so uniform in topographic features as the lower terrace.

A description of a typical profile of Riverton very fine sandy loam which is fairly well developed on the lower terrace follows:

0 to 7 inches, light grayish-brown very fine sandy loam with a single-grain structure. This layer contains scattered pebbles of water-worn cherty rock.

7 to 16 inches, light grayish-red or brown very fine sandy loam containing cherty fragments.

16 to 40 inches, reddish-brown very fine sandy clay containing many scattered cherty fragments. The reddish-brown color gradually merges with lighter reddish yellow as the depth increases. In some places gravel beds are present, whereas in other places they are lacking.

Table 5 gives the results of pH determinations on several soil profiles. These determinations were made in the laboratories of the Bureau of Chemistry and Soils, by the hydrogen-electrode method.

TABLE 5.—*pH determinations on several soil profiles from Mayes County, Okla.*

Soil type and sample no.	Depth	pH	Soil type and sample no.	Depth	pH
Parsons silt loam:	*Inches*		Woodson silty clay loam:	*Inches*	
452108	0- 8	6.0	452118	0- 6	6.3
452109	8-14	6.0	452119	6-14	6.3
452110	14-22	6.3	452120	14-26	7.3
452111	22-37	6.5	452121	26-40	7.7
452112	37-60	5.7	Labette silt loam:		
Bates very fine sandy loam:			452122	0- 5	5.5
452113	0- 7	5.6	452123	5-16	6.1
452114	7-14	5.3	452124	16-32	5.7
452115	14-29	5.0	452125	32-48	5.7
452116	29-38	5.4	Craig silt loam:		
452117	38-50	5.6	452137	0- 5	5.8
			452138	5-13	5.3
			452139	13-19	5.4
			452140	19-25	5.8
			452141	25-35+	5.9

RECOMMENDATIONS FOR THE MANAGEMENT OF MAYES COUNTY SOILS[1]

The physical and chemical compositions of the various soils in Mayes County differ greatly, consequently different systems of management are needed for them, depending on the character of surface and internal drainage, degree of soil acidity, deficiency of plant nutrients, and soil erosion. The majority of the farmers in this county have made no attempt to maintain or improve the fertility of their soils. Crop yields have gradually declined, and, because of the impoverished condition of the land, crop failures are not uncommon during unfavorable seasons. The total area of potentially productive soil is small, compared with the total number of acres in cultivation, consequently the average income of the farmers is low. No change in this condition is likely to occur so long as an extensive type of agriculture is followed, in which crops are removed from and nothing returned to the soil.

Although the total annual rainfall is high, excessive moisture and drought frequently are limiting factors in crop production, especially on areas where a high percentage of clay in the surface soil restricts the absorption of water or a claypan in the subsurface layer retards downward movement of water and a poorly drained condition develops, at least for a short time. Crops planted on soils containing too much clay, either in the surface or subsurface layers, are more seriously affected by drought than those on soils having a texture favorable to the movement of moisture and to root development. Upland soils containing a high percentage of clay in the surface layers should be used for grass, small-grain, and feed crops, and a comparatively small percentage of the land should be planted in crops which must be cultivated during the spring and early summer.

Soil acidity is one of the important factors restricting the growth of many crops in this county. Analyses have been made of 183 surface soils, and only 30 of them contain enough lime to support a good growth of alfalfa and sweetclover. Of these soils, 36 are slightly acid, 23 slightly+acid, 42 medium acid, 8 medium+acid, and 35 strongly acid. Most of the upland soils are acid, except those of the Summit series, which have been developed from limestone or calcareous shale, and still contain some lime in the surface or subsurface layers. The Bates soils are more acid in the subsurface layers than the Parsons soils, because the latter have a dense claypan which restricts the downward movement of water, and very little leaching occurs except in the surface layer. The cherty soils, which occur on the major part of the upland east of Neosho River, have developed from cherty limestone. These soils are very acid, because the calcium carbonate has been dissolved and completely removed by the excessive rainfall which passes into the subsoil and slowly seeps into the underground channels. Springs are formed where these underground channels reach the surface, as frequently happens on slopes. The chemical analyses of Lebanon silt loam, which is given in table 9, show the high acidity present in the subsurface layers of this soil.

[1] This section of the report was written by H. J. Harper, professor of soils, agronomy department, Oklahoma Agricultural and Mechanical College.

Although no experiments have been conducted in this county to determine the effect of different methods which may be used to utilize and control the movement of water on or into the soil, data obtained from other localities show that terrace ridges, spaced with a narrow vertical interval, reduce the absorption of total rainfall. Such a condition would be desirable on the Parsons soils, because excessive moisture interferes with tillage operations necessary for the control of weeds and the normal development of roots. When a soil is nearly saturated with water, a shallow root system is produced, and crops grown on such a soil suffer from drought at a time when similar crops grown on soils with better internal drainage are not affected. The summer rainfall can be utilized effectively when crops are planted in rows parallel with the terrace ridge. Consequently on soils where the internal drainage or surface drainage is imperfect, a surface-drainage system must be provided to remove excessive quantities of rainfall which frequently produce a waterlogged condition in comparatively level areas of land and on the lower slopes exposed to run-off water from higher land.

The deficiency of phosphorus is an important factor limiting crop production on the majority of the upland soils in this county. Analyses of the readily available phosphorus in 63 samples of surface soil were made, and all these soils except 10 should be fertilized with some form of phosphate fertilizer, in order to provide conditions favorable for maximum crop production. The results of these analyses show that 10 soils are high in content of phosphorus, 10 are medium, 22 are low, and 21 are very low. The content of readily available phosphorus was determined by extracting the soils with 0.2 N sulphuric acid.

Many farmers have been trying to increase their income by farming more land rather than by attempting to increase crop yields through a system of soil management which would include the use of legumes and limestone and phosphate fertilization. When fertilizers are applied, they should be used on crops which mature during a period when weather conditions are most favorable for plant development. The use of fertilizers on grain crops which grow during the summer is not recommended, because of the limiting effect of high temperature and lack of rainfall on crop yields. Fertilizers can be used profitably on wheat, barley, and many leguminous crops, and the residual effect of such treatment may frequently have a good effect on crops like corn, when favorable weather conditions prevail.

Table 6 gives the results of a fertilizer test conducted with corn on an area of Woodson silty clay loam.

TABLE 6.—*Effects of fertilizer treatment on the yield of corn in 1932 on Woodson silty clay loam, 2½ miles northeast of Mazie, Mayes County, Okla.*

Plot no.	Soil amendment	Rate of application per acre	Acre yield of corn
		Pounds	*Bushels*
1	None		18.4
2	Superphosphate (20-percent P_2O_5)	100	23.5
3	do	200	27.1
4	do	300	29.0
5	do	[1] 200	22.8
6	Triple superphosphate (45-percent P_2O_5)	45	24.6
7	12-24-12	83	27.7

[1] Side-dressed with 100 pounds of nitrate of soda when plants were 16 inches high.

A good increase in yield was obtained from an application of 100 pounds of superphosphate to the acre, applied in the row when the corn was planted; and a slight increase was obtained by increasing the rate of application of the superphosphate fertilizer. Triple superphosphate containing 45 percent of phosphoric acid produced as much corn as equivalent quantities of superphosphate containing 20 percent of phosphoric acid. An application of nitrate of soda when the corn was about knee high decreased the yield. This effect was probably due to the fact that nitrogen increased the plant growth, and, during periods of limited rainfall, the plants fertilized with nitrogen suffered to a greater extent than those that were not so large and whose water requirements were not so great. In many other tests, no effect from applications of phosphate fertilizers on corn was obtained, because of a lack of rainfall during the summer. The soils on which these experiments were conducted were deficient in phosphorus, and increased yields of crops would have been obtained from phosphate fertilization if moisture had not been a limiting factor in plant development.

A few farmers in this county have been increasing wheat yields by using superphosphate or complete commercial fertilizers, which are applied in the row with the seed at time of planting by means of a combination fertilizer distributor and grain drill. Such a system cannot be considered a permanent type of farming. The addition of superphosphate will maintain only the phosphorus and sulphur content of the soil. Wheat removes large quantities of nitrogen, and eventually nitrogen will become a limiting factor in crop production and the addition of a phosphate fertilizer will no longer increase the yield of grain. The use of a cropping system in which legumes are grown and returned to the soil is probably the best method of increasing the available nitrogen needed for crop production. Unfortunately, some of the legumes recommended for soil improvement cannot be grown on many of the soils in this county without the addition of lime and phosphate fertilizers. Sweetclover and alfalfa have been tried by many farmers in this locality, and failure has ensued except on the Summit soils and on bottom land where the soils are not acid and a good supply of phosphorus is present. On a majority of the upland soils, especially the Bates and Parsons soils, both limestone and phosphorus are needed for the successful production of alfalfa or sweetclover. Alfalfa should not be planted on the Parsons soils unless surface drainage is good and the top of the claypan is at least 18 inches below the surface of the ground. Alfalfa roots cannot live in a saturated soil. Consequently annual legumes should be grown on the Parsons soils in order to produce forage which is higher than prairie hay or Sudan grass in content of protein. A larger acreage of alfalfa should be grown. Liberal applications of limestone and phosphate fertilizer, which should be mixed thoroughly with the soil before the alfalfa is seeded, form the basis for the successful production of alfalfa on most soils. Top-dressing alfalfa with farm manure will produce a marked increase in yield under average conditions. More profit can be derived from applications of manure on alfalfa than on any other field crop.

The effect of the addition of lime and phosphates on the yield of sweetclover grown on Parsons silt loam is given in table 7. The

surface soil in this area was not strongly acid, and the subsoil contained some lime. The phosphorus content of this soil was very low, consequently a big response from phosphate fertilization was obtained. The analyses of composite samples of soil from this area, which were taken at 6-inch intervals down to 42 inches, are given in table 9 under Parsons silt loam, samples 2783 to 2789, inclusive.

TABLE 7.—*Effects of fertilizer treatment on the average yield of sweetclover grown in 1932 on Parsons silt loam, one-half mile south of Pryor, Okla.*

Plot no.	Treatment	Rate of application per acre	Method of application	Acre yield of forage
		Pounds		*Pounds*
1	None			686
2	Limestone [1]	400	Drilled with seed	1,360
3	do	3,000	Broadcast	985
4	do	6,000	do	812
5	Superphosphate (20-percent P_2O_5)	200	Drilled with seed	1,529
6	Rock phosphate (34-percent P_2O_5)	200	do	3,343
7	Superphosphate Limestone [1]	200 4,500	do Broadcast	3,696
8	Farm manure	24,000	do	2,492

[1] Agricultural limestone used, all passing through a 10-mesh sieve.

A good stand of sweetclover is often difficult to obtain because of the harmful effect of torrential rainfall on the young plants. Experiments indicate that sweetclover seed should be scattered on the surface of a comparatively firm seedbed about the middle of March. If weeds appear, they should be clipped before the first of July, as late clipping seriously injures the growth of sweetclover. This crop must establish a large root system the first season, in order to produce a large top growth the following year. The removal of the leaves by clipping or pasturing during the first season destroys the "factory where plant food is manufactured"; consequently less material is stored in the roots than would have been if the tops of the plants had not been removed. Pasturing sweetclover the first season is not so serious on good soils as it is on soils which contain a limited supply of available plant nutrients.

Improvement of the pastures may be accomplished, either by using tame grasses, such as redtop and orchard grass, or by removing the livestock from the fields, clipping the weeds, and allowing the native grasses to develop. Over-grazed pastures usually contain many small plants of native grass, but production is low because the plants are weak and produce a very small quantity of forage. Rest is the most important method to use in improving the growth of vegetation on these areas. Lespedeza and little hop clover are common in many pastures, and the nitrogen content of the soils should be increased by the growth of these legumes. Perennial ryegrass and black medic are two other plants which can be used to improve native pastures. As a rule, black medic does not make a good growth on acid soils, and it may be necessary to apply lime to many fields before a good crop can be produced. Seed of black medic and little hop clover should be scattered on pasture land in July or August, and Korean lespedeza should be seeded about the first of April. Little hop clover is a winter legume which begins to grow in the fall. The young

plants are dormant during the winter, and they mature in late spring or early summer, depending on weather conditions. On fertile soil this legume will produce about 1 ton of hay to the acre. When used for pasture, the most important grazing period is during April and May.

Korean lespedeza is a summer legume that can be pastured from June until frost. This plant will produce a much better growth on fertile soil than on soils which are acid and low in phosphorus. It is more likely to succeed when planted in small grain, if the rate of seeding of the small grain is reduced, especially on fertile soil where competition is unfavorable for the development of the legume seedlings. On land not too badly infested with weeds, every other opening in the drill may be closed, and this will space the rows of small grain about 14 inches apart. A wider space between the rows of small grain will increase the amount of sunlight and plant nutrients that are available for the young plants, and the plants will make rapid growth during the early part of the season. This increases the depth of the root system and improves the opportunity for the leguminous plants to survive during periods of drought, which frequently occur after the small grain is harvested. The use of lespedeza in a cropping system, with wheat or winter barley, in order to maintain the nitrogen content of the soil, should receive more consideration by farmers interested in the production of these crops.

A large number of experiments have been conducted with winter legumes on many different soils in northeastern Oklahoma. The seed should be planted about the middle of September, and the crops will mature in June of the following year. The results of some of these experiments are given in table 8.

TABLE 8.—*Average yield of hairy vetch and medium red clover on different soils in Mayes County, Okla., 1934 and 1935*

[Yields of hay in pounds per acre]

Soil type	1934		1935			
	Hairy vetch	Red clover	Hairy vetch [1]	Red clover [1]	Hairy vetch [2]	Red clover [2]
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Bates fine sandy loam	3,300	2,360	1,750	1,620	2,350	2,300
Craig silt loam	1,670	2,075	2,100	1,470	4,715	2,140
Lightning silty clay loam	2,525	3,210				
Parsons silt loam	4,200	3,320	1,545	1,760	3,050	2,110
Summit silty clay loam	2,960	3,165	2,640		3,170	
Verdigris very fine sandy loam			2,130	2,005	2,905	2,430

[1] No treatment.
[2] 150 pounds of 20-percent superphosphate drilled with seed.

Fertilizer treatment produced a larger increase in yield of hairy vetch than of red clover in most of the experiments, although the hairy vetch produced no second growth after it was harvested, and no measurements were obtained from the second growth produced on the plots of red clover. Hairy vetch has given better results than most of the winter legumes studied, because the seeds of this plant are large, and the problem of preparation of the seedbed is not so important for this crop as for plants having smaller seeds,

such as red clover and alfalfa. Yields of hairy vetch are, in general, slightly higher than those of red clover. Red clover, however, produces a second crop which can be used as green manure, and it is possible that this crop is more valuable from the point of view of soil improvement than the comparative yields may indicate.

A firm seedbed must be prepared for crops like red clover, sweetclover, or alfalfa; consequently where fertilizers are used they should be applied in advance of seeding, in order that the soil will have time to settle before the fine seeds are scattered over it. Crimson clover is a winter legume that should be tried more extensively because it has many desirable characteristics, such as character of growth and seed production, which should make it a good crop for forage or for soil improvement. Inoculation of legume crops is essential for the production of a vigorous growth on poor land, and it may require more than one trial on the same field before satisfactory yields are obtained.

Studies on the chemical composition of samples of soil types collected from virgin areas of land are given in table 9. These analyses show that some of the soils have been thoroughly leached by rainfall and that the total and readily available phosphorus content is very low, compared with that of highly productive soils. The nitrogen and organic-matter content of these virgin soils is above the average for Oklahoma, but the combined effect of continued cultivation and soil erosion has reduced the total content of nitrogen and organic matter in the average soil from 30 to 50 percent.

TABLE 9.—*Chemical composition of soils in Mayes County, Okla.*

UPLAND SOILS

Soil type and sample no.	Location	Depth	pH	Total nitrogen	Organic matter	Total phosphorus	Readily available phosphorus
		Inches		*Percent*	*Percent*	*Percent*	*Parts per million*
Bates fine sandy loam:							
3231	NE¼NE¼ sec. 12, T. 22 N., R. 18 E.	0–5	6.1	0.244	4.03	0.032	6
3232		5–13	4.9	.108	2.42	.038	1
3233		13–26	4.7	.103	2.16	.045	1
3234		26–44	6.0	.057	.53	.019	0
Bates very fine sandy loam:							
3225	NE¼SE¼ sec. 20, T. 22 N., R. 19 E.	0–7	5.6	.298	3.85	.023	1
3226		7–14	5.1	.180	1.47	.015	0
3227		14–29	4.7	.150	.64	.010	0
3228		29–38	5.5	.141	.33	.005	0
3229		38–50	5.6	.097	.09	.004	1
Bates very fine sandy loam:							
886 [1]	NE¼ sec. 28, T. 22 N., R. 20 E.	0–6	5.7	.133	2.70	.016	18
887		12–18	6.0	.110	1.68	.015	6
Craig silt loam:							
3236	NE¼NE¼ sec. 7, T. 23 N., R. 21 E.	0–5	5.7	.165	1.49	.027	1
3237		5–13	5.5	.075	[2] 2.24	.037	1
3238		13–19	5.4	.062	3.83	.032	0
3239		19–25	5.3	.078	[2] 2.17	.028	0
3240		25–35	8.0	.017	.82	.031	1
Hanceville fine sandy loam:							
3253	NE¼SE¼ sec. 7, T. 22 N., R. 18 E.	0–4	8.9	.086	2.57	.054	36
3254		4–8	8.5	.020	.65	.060	1
3255		8–24	6.8	.022	.55	.053	0

[1] Sample taken from cultivated field.

[2] Data for organic matter probably too high, owing to the effect of other reducing substances on chromic acid which was used as an oxidizing agent.

TABLE 9.—*Chemical composition of soils in Mayes County, Okla.*—Continued

UPLAND SOILS—Continued

Soil type and sample no.	Location	Depth	pH	Total nitrogen	Organic matter	Total phosphorus	Readily available phosphorus
		Inches		*Percent*	*Percent*	*Percent*	*Parts per million*
Labette silt loam:							
3275	NW¼NE¼ sec. 18, T. 21 N., R. 20 E.	0–5	5.6	0.123	2.89	0.034	2
3276		5–16	5.8	.114	2.74	.027	6
3277		16–32	5.1	.077	1.44	.019	0
3278		32–48	5.3	.049	.58	.047	80
Lebanon very fine sandy loam:							
3221	SW¼NE¼ sec. 6, T. 21 N., R. 21 E.	0–5	4.9	.127	1.19	.018	1
3222		5–12	4.9	.121	.66	.014	1
3223		12–38	5.3	.117	.24	.024	0
3224		38–50	5.7	.111	.24	.022	0
Lebanon very fine sandy loam:							
132	NE¼NE¼ sec. 1, T. 22 N., R. 21 E.	0–2	6.9	.198	2.55	.029	4
133		2–8	4.7	.036	[2] 3.71	.029	2
134		8–11	4.8	.042	1.72	.035	4
135		11+	4.8	.048	1.28	.027	3
Newtonia very fine sandy loam:							
3241	NE¼NE¼ sec. 23, T. 23 N., R. 20 E.	0–6	7.5	.083	3.85	.034	2
3242		6–14	6.3	.048	.79	.030	1
3243		14–40	6.4	.041	.58	.041	3
Woodson silty clay loam:							
3262	NE¼NW¼ sec. 36, T. 23 N., R. 19 E.	0–6	6.5	.190	5.00	.023	2
3263		6–14	6.6	.114	3.03	.014	1
3264		14–26	7.3	.086	2.12	.009	0
3265		26–40	8.1	.043	.99	.009	24
Parsons silt loam:							
3247	NE¼SE¼ sec. 20, T. 22 N., R. 19 E.	0–8	5.4	.146	3.66	.021	1
3248		8–14	5.4	.066	1.59	.013	0
3249		14–22	6.0	.128	2.45	.012	0
3250		22–37	6.5	.049	.67	.011	0
3251		37–60	6.1	.015	.34	.010	0
Parsons silt loam:							
890 [1]	SW¼SE¼ sec. 24, T. 19 N., R. 18 E.	0–6	5.7	.148	3.03	.021	12
891		12–18	5.7	.077	1.40	.014	6
Parsons silt loam:							
2783 [1]	NE¼SE¼ sec. 18, T. 21 N., R. 19 E.	0–6	6.1	.076	1.54	.015	6
2784		6–12	6.5	.057	1.35	.014	4
2785		12–18	6.8	.070	1.30	.009	2
2786		18–24	6.8	.047	.99	.007	2
2787		24–30	7.4	.059	.60	.006	2
2788		30–36	7.4	.023	.24	.005	2
2789		36–42	7.5	.023	.48	.005	2
Summit silty clay loam:							
3271	NW¼NW¼ sec. 16, T. 22 N., R. 20 E.	0–4	6.1	.208	7.03	.028	8
3272		4–9	8.2	.070	1.66	.007	6
3273		9–20	7.6	.079	1.90	.009	6
3274		20–40	7.9	.027	.77	.005	24

BOTTOM-LAND SOILS

Lightning silty clay loam:							
3259	NE¼NE¼ sec. 19, T. 22 N., R. 19 E.	0–6	5.9	0.227	5.31	0.056	15
3260		6–19					24
3261		19–40	5.6	.083	1.78	.025	3
Lightning silt loam:							
3266	SW¼SE¼ sec. 1, T. 21 N., R. 18 E.	0–5	5.5	.246	7.46	.051	18
3267		5–18	5.6	.089	1.64	.017	0
3268		18–27	5.8	.060	[2] 3.27	.013	0
3269		27–37	4.8	.050	.79	.050	10
Riverton very fine sandy loam:							
3256	NW¼SW¼ sec. 23, T. 21 N., R. 20 E.	0–7	7.0	.091	1.97	.022	1
3257		7–16	5.6	.077	1.47	.018	1
3258		16–40	5.4	.066	1.84	.017	1
Verdigris very fine sandy loam:							
3244	NW¼NW¼ sec. 21, T. 22 N., R. 18 E.	0–5	7.4	.190	4.43	.045	8
3245		5–14	5.5	.085	2.17	.041	4
3246		14–40	7.6	.034	.79	.027	1

[1] Sample taken from cultivated field.

[2] Data for organic matter probably too high, owing to the effect of other reducing substances on chromic acid which was used as an oxidizing agent.

In order to increase the nitrogen content of cultivated soils, legumes must be grown and the residue returned to the soil. Fertilizers and limestone should be applied, if needed, in order to provide conditions favorable for maximum crop production. The type of farming in many instances must be adapted to soil conditions. Where the physical conditions of the soil are favorable, a more intensive type should be developed, because higher crop yields are one method of decreasing the cost of crop production and increasing farm income. Soils that are less productive because of internal or external characteristics can be farmed economically only when a large acreage of land is available. Farmers without capital would have a difficult task in improving land where the natural fertility is exhausted. This condition is responsible for some of the social problems prevailing on areas of marginal and submarginal land.

SUMMARY

Mayes County is in northeastern Oklahoma partly within the eastern prairies and partly in the western Ozark region. Pryor, the county seat, is about 40 miles northeast of Tulsa and about 70 miles southwest of Joplin, Mo.

The climate is humid and continental. The high annual rainfall is not always well distributed. The temperature is very warm in summer and moderately cool in winter. Climatic conditions are favorable for a diversified type of agriculture.

The general farm practice consists of growing small grains, grain sorghums, hay, cotton, and corn, with some fruit and vegetables. The dominance of these crops is largely a natural response to the character and suitability of the soils. The grain sorghums are more naturally suited to this section than corn, but many farmers still prefer to grow some corn. Some livestock is raised on most farms, and some dairying is carried on.

The county is characterized by narrow undulating prairies extending in a general north-south direction through the central part, bordered on the east by the foothills of the Ozarks which terminate approximately at Neosho River, and on the west by forested sandstone hills, locally known as the Dog Creek hills, a division of the so-called cross timbers area.

The principal geological exposures comprise some of the Pennsylvanian and Mississippian formations consisting mainly of shales, limestones, and sandstone. As all the county lies within the humid region, the soils are under the influence of pedalferic development. Originally the land was covered by a hardwood forest in the eastern or Ozark section and in the cross timbers area, and by a grass vegetation on the prairies. The native vegetation has plainly influenced the characteristics of the various soils.

Some of the soils are well drained, and some are imperfectly drained. The imperfectly drained soils are podzolic, and this indicates a less productive condition than that of the dark Prairie soils. The soils have developed under a heavy rainfall and have been considerably leached of soluble plant nutrients. The soils having well-developed characteristics are for the most part low in organic matter. Nitrogen and phosphorus are elements lacking in most of the

upland soils, and the addition of these in fertilizers greatly increases crop production.

Some of the upland soils covering large areas are underlain by dense claypans and some by hardpan. This physical feature affords conditions unfavorable for crops.

The soils of the Parsons and Woodson series have dense claypan subsoils, and those of the Lebanon and Craig series have hardpan subsoils. These characteritics make these soils difficult to cultivate during extreme wet or extreme dry conditions. The Hanceville and some of the Bates soils are very sandy, and the sloping areas erode readily. All the above-mentioned soils when handled properly can be made to produce well.

The steeper slopes along the foothills of the Ozark section are badly eroded, and the cherty rock is exposed in large areas. Most of the soils in the prairie section are dark and have developed from gypsiferous shales and argillaceous sandstones.

The supply of organic matter in the darker Prairie soils, together with their inherent productiveness, makes corn growing successful when moisture conditions are favorable, but when the organic matter is depleted the production of corn is less satisfactory. Very little commercial fertilizer is used at present, but research agencies of the Oklahoma Agricultural and Mechanical College are rapidly ascertaining the fertilizer requirements of the various soils and giving this information to the farmers.

The light-colored soils in the eastern part of the county are used principally for a subsistence type of farming on the small farms. Probably more livestock is needed for the consumption of the principal crops—corn, oats, sorghums, and hay. Corn and oats are used principally as feed crops for local requirements, and wheat and cotton are shipped out. A large proportion of the corn is fed to livestock, principally hogs. The raising of beef cattle has been profitable, owing to the large supply of cheap hay and pasture. Much of the corn is also used in fitting cattle for market.

The natural conditions determined by the characteristics of the soils, supplemented by the climate of this section, favor the production of many different crops and also a wide diversity in agricultural activities.

Fruits and vegetables are produced mainly to supply the rural homes and the local markets.

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SOIL MAP
MAYES COUNTY
OKLAHOMA

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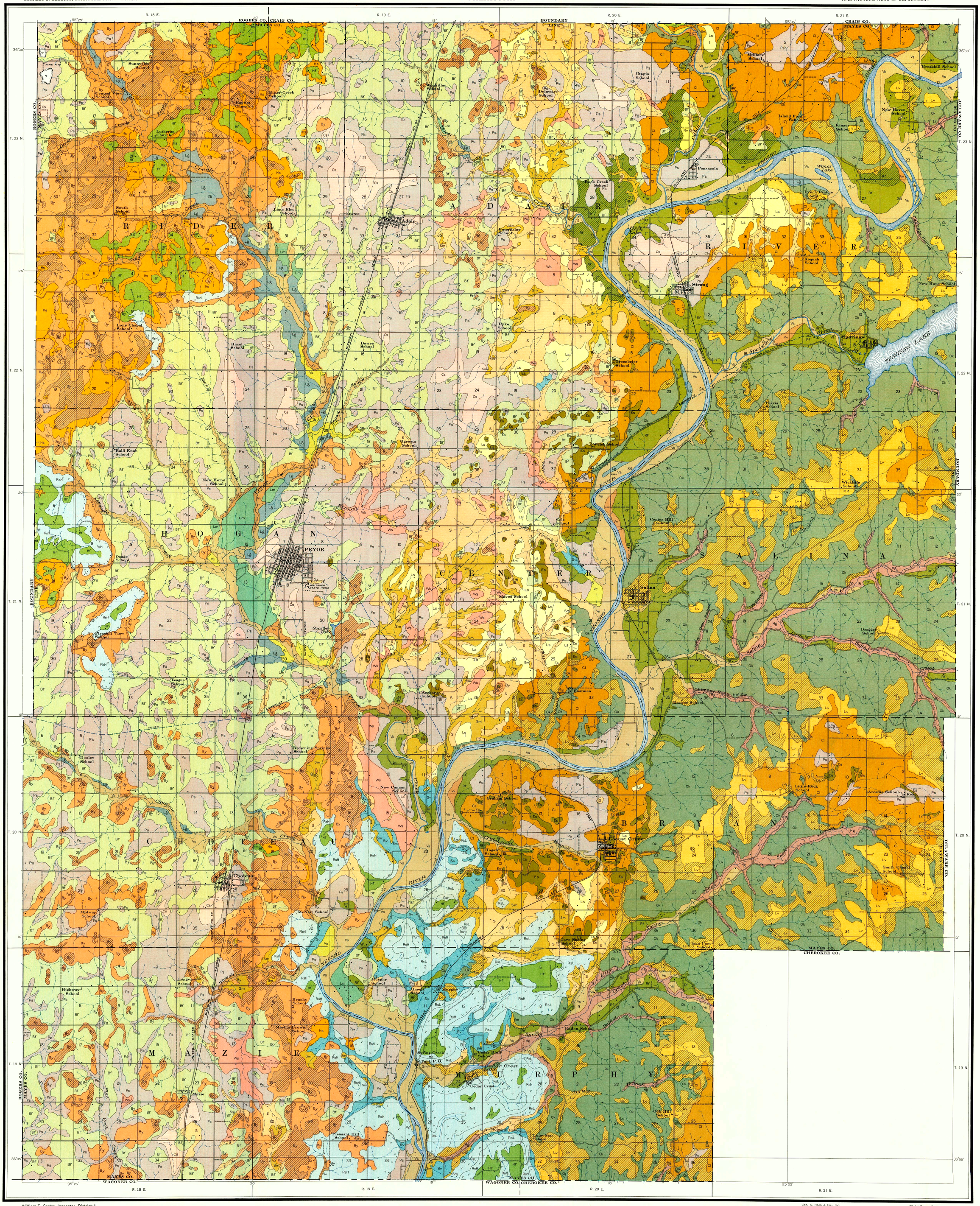
R. 18 E.
R. 19 E.
R. 20 E.
R. 21 E.
95°25'
95°05'
36°30'
T. 23 N.
25'
T. 22 N.
20'
T. 21 N.
15'
T. 20 N.
10'
T. 19 N.
36°05'
ROGERS CO.
CRAIG CO.
MAYES CO.
DELAWARE CO.
WAGONER CO.
CHEROKEE CO.
BOUNDARY LINE
Adair
PRYOR
Salina
Strang
Spavinaw
Locust Grove
Chouteau
Pleasant View School
Lone Elm School
Enterprise School
Dyke School
Dawes School
Hazel School
Lone Chapel School
South School
Sunnyside School
Central View School
Lutheran Church
Baptist Church
Bitter Creek School
Washillan School
Delaware School
Utopia School
Military School
Breakbill School
New Haven School
Island Ford School
Kinzer School
Pensacola
Bark Creek School
Lynch Prairie School
Roquah School
New Hope School
Wimar Lake
Park Lake
Spavinaw Creek
SPAVINAW LAKE
Parris School
Welch School
Wickliffe School
Center Hill School
Cole School
Mayes School
Osage School
Bald Knob School
New Home School
Osceola School
Orchard School
Dooley School
Browning Springs School
Teague School
Scarboro Dale
Whitaker Estate Home
New Canaan School
Graham School
Little Rock School
Arcadia School
Smith Chapel School
Hogan School
Cave Springs School
Bean Post School
Dragger School
Baton School
Cedar Bluff School
Cedar Crest School
Oak Hill School
Lone Star School
Pleasant Hill School
Mazie
Maxie Brown School
Brushy School
Longview School
Highway School
Omega School
Murphy School
Boatman
Beaver School
Arbuckle School
Tank P. O.
Spring Creek P. O.
Saline
Chimney Rock Hollow
Cedar Crest Hollow
Hogskin Hollow
Spring Branch
Bird Creek
Mud Creek
Pryor Creek
Dog Creek
Lightning Creek
Cole Creek
Brush Creek
Brushy Creek
Little Saline Creek
Saline Creek
Saline Creek Bottom
Cabbage Hollow
Bird Creek Bottom
Spring Branch
Spring Creek
Cedar Crest Branch
Hogan Creek
Hogan Creek Bottom
Dog Hollow
Mud Creek Hollow
Scarboro Dale Hollow
Saline Creek Bottom
Little Saline Creek Bottom
Bird Creek Bottom
Spring Branch Bottom
Cedar Crest Branch Bottom